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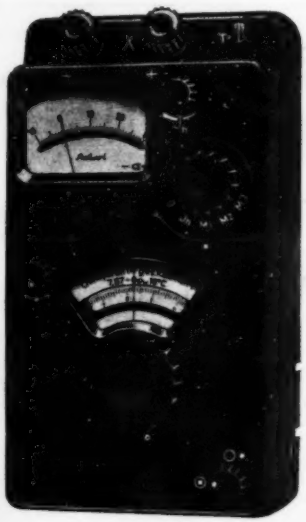

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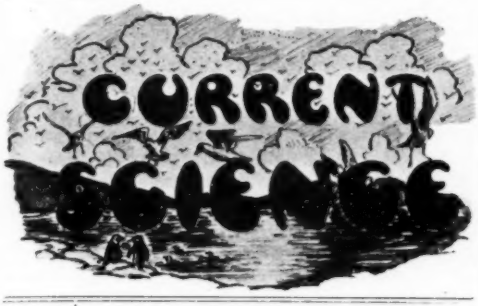

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Indian Public School.

THE extracts from the report of the Indian Public School Committee, which have recently been published in the Press, are sufficiently full to enable the discerning public to form a fairly correct estimate of the value and significance of the institution proposed to be established early in the next year at Dehra Dun. Some of the important features of the recommendations of the Committee, which have all been accepted by the Government of India, are that the School, as was originally conceived by the late Mr. S. R. Das, is to be founded on the model of the English Public Schools; its first Head Master and the Assistant Masters are to be Englishmen possessing an intimate knowledge and experience of the work and organisation of English Public Schools; the aims and ideals of the Indian Public School will develop in an atmosphere of Indian culture and environment; the courses of study provided for the pupils will be sufficiently varied so as to offer scope for individual differentiation, and the social, religious and communal solidarity will be promoted by the genial influence of a common messmatism and comradeship in compulsory games. The School is proposed to be located in the buildings of the Imperial Forest College and Research Institution which together with the surrounding grounds have been acquired at a cost of three lakhs of rupees; and for the construction of additional structures and for endowment of funds the Committee have fourteen lakhs of rupees in their possession, which they hope to supplement from public benefactions. As a tentative measure residential accommodation has been provided in the main building for two sections with sixty boarders in each. The minimum and maximum ages of the first batch of scholars are fixed at eight and twelve years, which in the successive stages will be raised to twelve and nineteen, involving the gradual abolition of the lowest classes. The administration and general control of the School will be vested in a Board of Governors consisting of officials occupying exalted positions. Presumably the School is going to start on its career of usefulness under the most august and propitious circumstances.

The scheme is undoubtedly irreproachable. The ambitions of its promoters are truly praiseworthy.

The aims and objects of the School which

have been described in detail by the Committee appear to us, however, precisely identical with those about which we are daily accustomed to read in the addresses and speeches made on the ceremonial occasions of laying the Foundation Stone, or the annual prize-giving functions of primary and high schools in India. We are confident that no important pronouncement is made at these gatherings without a generous reference being also made to the schools developing "in an atmosphere of Indian culture and social environment" and that the outlook of the whole school should be distinctly moral and spiritual. Every convocation address is adorned by exhortations to the graduates on the importance of cultivating self-discipline, building up of a lovable character, developing the capacity for corporate action in civic life and fostering the spirit of chivalry and fairplay in normal human dealings. When School "days" are celebrated, the gentleman, "gracing the occasion with his distinguished presence," devotes his whole speech to extolling the quality of manliness and self-reliance and to persuading the young scholars to be free from the taint of social, communal and provincial prejudices and to cultivating the spirit of "united nationhood".

In the course of his scholastic career, a young pupil is destined to listen to such exhortations on at least 20 occasions and the need for them indicates that the unassisted efforts of education are inadequate to fortify his mind against the malign influences of the world which he is about to enter. While we admit theoretically that man is made in the image of God, we practically adopt the Jesuit doctrine that the young man harbours in his soul the author of evil, who is to be exercised by speeches and birches. The essence of education as we practise it is an elaborate attempt to convert the natural human animal into a conventional mechanised being, and every instrument which civilised society could invent is requisitioned for completing this process of metamorphosis. From the days of which we possess any historical record down to modern times, progressive education, apart from "illuminating the mind", has been a ceaseless struggle in the attempt to weave a rigidly uniform moral and spiritual garb for its votaries, and in this enterprise all the auxiliary forces of public opinion, the church and the state are enlisted. The fact that the report of the School Committees, the speeches addressed to youth in schools and colleges insist on the prescription of religious and moral instruction as an integral part of the educational programme must be a sorry commentary on the essence of human nature, which, at the least provocation, is apprehended like Arthur's Kingdom to reel back to the beast. The reason for this constant repetition of levitical doctrines in educational reports is due to our inadequate recognition of the law of change in the realm of objective reality and in the world of thought. The progress of science has altered our conception of the human mind and of the constitution of matter. The young men who are nurtured on the milk of the new philosophy inevitably subject all fundamental ideas to re-examination untrammelled by the "word of man", and they will not hesitate to go down to the very basis of things. We deliberately stimulate in the young men this spirit of unfettered enquiry in the sphere of intellect. Could we then curtail this newly discovered freedom from extending its influence into other domains? A conflict inevitably arises on the discovery that the progress of intellect has outstripped that of the other component parts of the mind, and modern education is confronted with this disjunction of intellectual and moral faculties. It is unable to equalise the pace of mind in the different fields of thought because of its adherence to an ancient code of conduct on the one hand, and on the other, its loyalty to freedom in the intellectual sphere. We are trying to put the heady wine of modern scientific knowledge into an old world ethical bottle; and the restlessness of the present age is the product of this attempt; and until the Church evolves a more satisfactory code of morality and a more rational system of spirituality, we shall have to continue to repeat the formulæ which form the staple of all educational reports and addresses.

The idea of an Indian Public School on the English model is not new; the various schools which commemorate the memories of Bishop Cotton, Baldwin and Lawrence are organised on the best traditions of the English public schools. They were originally intended for the benefit of children belonging to the domiciled Anglo-Indians, but more recently children of other communities also are admitted. We find in

them large numbers of day boys and resident scholars; the study and dormitory system; that unmitigated public nuisance of a personage, *viz.*, the monitor, prefect or preceptor; compulsory games; a staff of European Head Masters, Assistant Masters and Matrons; a delicately adjusted code of corporal chastisement; and finally, scout corps and military training including practice in pugilistic exercises. The Viceroy and the Provincial Governors, who are usually invited to preside at the ceremonial gatherings of these institutions, listen with great patience and interest to the reports of the Head Masters narrating the achievements of their pupils and in their replies, they pay glowing tributes to the excellent performance of the schools. The pupils are trained for public service in all its branches, for technical professions and for a military career; but few elect to proceed to higher education in the Universities. We have actually therefore a large number of Indian Public Schools in full action following the traditions of their English counterparts.

The English public school is certainly an elusive subject which "comprises in itself a difficult study of no inconsiderable magnitude," and within recent times the entire system has been criticised. The great head masters such as Dr. Butler, Arnold, Thring, Sanderson and Almond, who by their personal qualities built up great schools from small foundations, differed radically in everything that was essentially of educational importance. So different is the outlook of these schools that it is commonly said that "what are truisms at Rugby are paradoxes at Harrow, and an Eton custom would prove a Marlborough revelation." In spite of broad differences in the type, the English public schools occupy an important position as educational centres, and so great has been their influence on public life that even secondary schools and national schools are coming more and more to be run on public school lines. The European schools in India, which reflect the principal characteristics of the British system and which have been in existence for a long time, have not attained the reputation and influence on the public life which the English public schools possess. This is due not so much to their exclusiveness and want of adequate financial support as to the preferential treatment of these schools. The English public schools, on the other hand, owe their eminence to the surpassing fame of the head masters, distinguished alike by their scholarship, piety and public zeal. Their devotion to an ideal altered the face of education all through the public schools in England in a manner which neither government grants nor even popular support could have produced. They organised their own machinery, evolved their own principles of administration and invented their own methods of teaching, to each of which they imparted touches of their personal character.

We have heard a great deal about the criticisms on the games, punishments, the monitorial system and the exclusive spirit of the English public schools; but in the long course of their existence, some aspects of the school activities are apt to receive greater emphasis. Judged, however, from the widest point of view the English public schools are an invaluable heritage of the British people. Their pupils adorn their calling with their own particular aptitudes and knowledge, their own qualities of willingness to accept responsibilities and their ability to set an example wherever their lot may be cast. It is perfectly legitimate for the leaders of Indian public life to desire to found an institution in India turning out a band of brave, helpful and chivalrous Indians ready to shoulder cheerfully responsibilities and to regard service as its own reward.

Does the projected Indian public school possess the seeds which will germinate its greatness? It seems to us that while government support and supervision are an asset to all educational institutions, its inspiration and practical guidance may hamper the growth of the schools. None of the great public schools in England, none of the great scientific institutions, none of the universities owe their origin to government initiation. It is men with a missionary zeal for an ideal that create public institutions, to whom worldly goods and recognition are entirely of subordinate consideration. The Indian Public School is proposed to be brought into existence under slightly different auspices. The catalogue of aims and objects intended to be achieved by the Indian Public School is not its monopoly, and perhaps represents the pious wishes of its promoters. We are told that the School is to develop in an atmosphere of Indian culture and environment, but the conditions created for its management seem almost hostile to the realisation of this object. A number of

European teachers surrounded by children between the ages of eight and twelve, separated by language barriers and ignorance of each other's mental presuppositions, is suggestive of the tower of Babel rather than a seminary for fostering culture. Moreover, Indian culture and environment cannot successfully be hoped to be cultivated through optional studies of Indian vernaculars and classics, and an Englishman fresh from England,—if he is a reasonably humble and wise person—will refuse to be their exponent.

The moral and spiritual development of the school children is to receive the special attention of the masters; while it is fairly easy to grasp the exact connotation of the former term, the latter is a trifle puzzling. It seems to us that the work of the pupils in the class-room and their extramural activities should be founded on a moral basis rather than that we place before the immature minds, a code of illusive doctrines. The moral sense has to grow as an integral part of the development of the intellect and no teacher, however eminent, can hope to accomplish this seemingly impossible task unless he is thoroughly conversant with the racial history, family traditions and the mental make-up of the children. It is almost impossible to achieve spiritual unity in a heterogeneous assemblage of pupils, who follow different persuasions, and if by spirituality we mean God-mindedness and not what pertains to religion, perhaps schools might attempt to produce it without ecclesiastical assistance. The Indian Public School is proposing to achieve what the government and aided institutions have tried, and are silent about the fruits of their labours. Are we justified in investing nearly 20 lakhs of rupees with further financial implications, on an institution whose ostensible object is to turn out 50 or more young men annually, who will be moral, spiritual, chivalrous with a capacity for corporate actions and for military, professional and university training? Cannot the same results be obtained by re-organising and consolidating a few of the selected European schools in India where the traditions of the English public schools are reproduced? The success of the Indian Public School and the establishment of its reputation as an educational centre are not financial and pedagogical problems; they are, however, assured if the European officers in India consent to send their children to this institution to be trained along with Indian children. Their interest in the institution would then become personal, instead of remaining academic. We can conceive of only one justification for bringing so costly an institution into existence. The Indian child is a biological organism,—not of the variety of Strasburg goose;—and is to be trained to acquire a view of the world in perspective and to realise that what he does or thinks is not the product of one community or one country and that he himself is the citizen of the world as a whole. The morality and spirituality that the Indian child—like every other child,—has to learn in the Indian Public School ought to consist in the paramount duty to join the rest of the world in a spirit of co-operation to improve the lot of his fellow-men irrespective of territorial, racial and language barriers. If the Indian Public School succeeds in producing this frame of mind in its pupils, it will be the only justification for its continued existence and public support.

Survey of Commercial Indian Cottons.

By R. D. Mihra, M.A., B.Litt. (Oxon.),
Publicity Officer, Indian Central Cotton Committee, Bombay.

A BOTANICAL survey of Indian cottons must necessarily cover an extraordinarily cumbersome range of types some of which are of scarcely enough importance as commercial commodities. Nevertheless what is left of the more important types which dominate the economy of the country's cotton industry embraces perhaps one of the most divergent ensemble of types to be found in any single important cotton-producing country of the world. Climate, soil and other natural dispensations which govern the organic susceptibilities of the flora of this country vary, sometimes at sharp angles, from region to region, and it is not at all surprising that cotton culture ramified throughout the length and breadth of the country, sometimes in sporadic, discontinuous patches and sometimes with immense continuity of range, should present such a complex variety of types and economic values.

GEOGRAPHICAL DISTRIBUTION OF TYPES.

In attempting a botanical survey, I shall confine myself, for the present, to such of the types of cotton grown in India as are of proved economic value, either in the light of present conditions or of the prospects which a decade of outstanding research has already ushered in.

The general name given to the cottons grown on the Indo-Gangetic plain is "Bengals", the chief sub-classes under this group being "Sind-deshi", "Punjab-deshi", "Rajputanas" and "United Provinces".

The "Oomras" occupy large areas of the Central Provinces, Central India, Berar, Khandesh, Nasik and the Nizam's Dominions. The "Oomras", however, comprise nearly half a dozen sub-types variously distributed in the above-mentioned areas. The "Broach" and "Dhollera" varieties are grown largely in Gujerat, the latter chiefly in the north and extending to Kathiawar. The "Kumptas", "Westerns" and "Northerns" largely occupy adjacent areas, the first, in southern part of the Bombay Presidency and the last two extending away to the east, occupying the northern part of the Madras Presidency and the southern part of the Nizam's Dominions. "Dharwar-American" and "Gadag No. 1"—the former an upshot of efforts to introduce American cotton—are grown almost exclusively in the Dharwar District. "Punjab-American", also an acclimatised upland American cotton, occupies nearly a million acres in the Canal Colonies of the Punjab. "Tinnevellys"—a mixture of two distinct types—"Karunganni" and "Uppam"—is grown in about 600,000 acres in the districts of Madura, Ramnad and Tinnevelly, but is gradually giving place to pure "Karunganni". "Cambodia"—a type of American Upland flourishing throughout the southern cotton-growing tracts of the Madras Presidency—is found chiefly in the district of Coimbatore (Tiruppur) and in the western part of the district of Madura. It occupies nearly 350,000 acres.

"Comilla" which derives its name from a town in Assam is almost exclusively confined to Eastern Bengal and Assam.

CHARACTERISTICS OF TYPES.

"Bengals" form, on the whole, the shortest staple cotton in India. They almost always consist of a mixture of various varieties of *Gossypium neglectum* with a variable percentage of *Gossypium indicum*. The staple length of "True Bengals" varies from 4/8 to 5/8 inch and in the case of "Ordinary Bengals" from 3/8 to 4/8 inch. They are coarse but usually of good colour. "Sind" and "Punjab-deshi" contain nearly the same varieties and possess staple of nearly the same length. The "deshi" variety in the Punjab contains almost everywhere at least 4 different types.

The "Oomras" comprise five distinct varieties known as (1) "Bani" or "Gaorani", (2) "Berar cotton" composed of a mixture of varieties of *Gossypium neglectum*, (3) "Central Provinces cotton", (4) "Khandesh" and (5) "Central India cottons". "Bani" consists essentially of *Gossypium indicum* with a ginning percentage of 25 and has a low acreage yield. Of indigenous Indian cottons, it is the finest with a staple length of over 1 inch. "Berar cotton" has a staple length varying from 5/8 to 6/8 inch with a certain amount of *Gossypium indicum*. The "Central Provinces cottons" consist of a mixture of different varieties of *Gossypium neglectum* with a certain amount of "Bani". The ginning percentage of "Khandesh" variety varies

from 33 to 38 and its staple length is nearly 1/8 of an inch less than that of "Berar cotton".

"Central India cottons" vary in quality from "Khandesh" to a type approaching the best "Central Provinces cotton". One of its varieties known as "Malwa" consisting entirely of the best type of *G. neglectum* has a staple length of from 6/8 to 7/8 inch, though a somewhat low ginning percentage.

"Broach cotton" consists of a mixture of varieties of *Gossypium herbaceum* the best of its types reaching a staple length of 7/8 to 1 inch, though, further north of Navsari, the quality tends to get lower. Its ginning percentage varies from 30 to 32.

The standard types of "Dholleras" locally known as "Wagad" and "Lalio" consist of *Gossypium herbaceum* and have a staple length varying from 5/8 to 7/8 inch and a ginning percentage of 33.

The "Westerns" and "Northerns" closely resemble the "Kumptas" and are composed of a mixture of varieties of *Gossypium herbaceum* and a variable proportion of *G. indicum* with a staple of from 6/8 to 7/8 inch.

The "Dharwar-American" a mixture of Upland American (*G. hirsutum*) and New Orleans (*G. mexicanum*) is an acclimatised type slightly inferior in staple to "Kumpta" but with a ginning percentage of 30 and not nearly so leafy.

The "Punjab-American" is also an acclimatised Upland American, with a colour and style very closely resembling ordinary Upland American. The ginning percentage is about 32. This cotton has a tendency to poor response in the absence of adequate irrigation in length and strength. Its staple length is about 0·9 inch.

"Tinnevelly" is a mixture of "Karunganni" a variety of *G. indicum* and "Uppam" (*G. herbaceum*). It is a dry land crop and flourishes on black soil of varying depth and natural fertility. Its staple length varies from 6/8 to 7/8 inch and it has a ginning percentage of 27, has a slight creamy colour, and is strong. It is sown in October-November and is harvested between March and August.

"Karunganni" a variety of *G. indicum* is white in colour with a ginning percentage of 25 to 26, and a staple length of 9/10 to 1 inch. Tests have definitely established its superiority over "Uppam" both in point of staple and outturn.

"Cambodia" flourishes in light red soils irrigated from wells and belongs to the Upland American variety (*G. hirsutum*). It is sown in September-October and harvested from April to May, allowing for a second picking 2 months later.

"Comilla" (*G. cernuum*) with a subvariety (*G. cernuum sylhetense*) of khaki coloured lint, is distinguished for the size of its bolls which sometimes attain a length of nearly 8 inches. Its staple is short, about only 3/8 to 4/8 inch, ginning percentage varying from 43 to 50. Its lint is very harsh in feel and the cotton is therefore used as an adulterant with wool.

Zesde Internationaal Botanisch Congres, Amsterdam, 1935.

THE Sixth International Botanical Congress will be held at Amsterdam from 2nd to 7th September 1935. An influential organising Committee with Prof. F. A. F. G. Went as President and Dr. M. J. Sirks as Secretary has been formed to work out the details of the programme. It may be mentioned in this connection that the Fifth Congress was held at Cambridge in 1930 when Prof. A. C. Steward was the General President and the proceedings of the Congress have been published as the "Report of Proceedings" which form an important addition to the Botanical literature of the World.

Dr. Birbal Sahni, D.Sc., Sc.D., F.G.S., F.A.S.B., Professor of Botany, University of Lucknow, has been invited to accept the Vice-Presidentship of the Section of Palæobotany. Prof. Sahni was appointed to the same post in the last Congress held at Cambridge when the late Dr. D. H. Scott was the President of the Section of Palæobotany. The Professor enjoys an international reputation, and the distinction conferred on him a second time will give general satisfaction to scientists throughout the country. In offering Prof. Sahni our warmest felicitations, we venture to hope that at the next Congress he will be invited to occupy the Presidential Chair.

The Indian Mango.

By Dr. P. Maheshwari,
Agra College, Agra.

THE original home of the mango is not known with certainty, but it has long been one of the most familiar trees about villages in India. There are many orchards of the finer varieties and the fruit is greatly praised. Many roads are lined with stately trees, giving a welcome shade during the hot season, as the tree is evergreen.

The different varieties of *Mangifera indica* L. produce flowers at slightly different times and blooming is somewhat earlier in the southern part of the peninsula than in the north. In the United Provinces of Agra and Oudh the height of blooming is in February and early March. The flowers are borne in large pyramidal profusely branched panicles with the ultimate branchlets cymose. The number of flowers in each inflorescence may vary from 1,500 to 4,000, and the varieties with better fruit seem to have the largest inflorescences.

The flower usually consists of 5 sepals, 5 petals, 5 stamens and a single carpel. There is some variation in the number of stamens and occasionally a flower may show primordia of all ten stamens—a rather common thing in other members of the family. Characteristically, however, only one stamen develops and the other four remain abortive. The ovary contains a single anatropous ovule. The style arises from the edge of the slightly compressed ovary. The fertile stamen is on the opposite side of the flower and is of the same diameter as the style. Rarely 2 carpels and less rarely 2 fertile stamens may develop.

In spite of the large number of flowers produced in a single inflorescence, it is well known that ordinary village trees produce on an average only 2-3 fruits per inflorescence and even the best varieties do not commonly have more than half a dozen. Most of the flowers dry up soon after blooming and fall off. A study of microtome sections reveals the fact that these have an abortive ovary and can function only as pollen-producers. Perhaps only 5-10% of the flowers that open have normal-looking ovaries. After a slight enlargement most of the ovaries turn yellowish, shrivel up, and the entire flower drops off. Of the few that remain, most drop off at the size of a small pea. The very few that survive this period usually continue to develop further. The flowers with normal-looking ovaries occur mostly towards the apex of the inflorescence and are mainly the primary flowers of the little cymes and to a less extent the secondaries; a tertiary flower of the cymelet almost never produces a good ovary. Later appearing tertiaries and quaternaries are likely to fall off while they are still small buds.

Besides the high mortality of the flowers, it is also a matter of common experience that while fruits are produced in fairly large quantities one year, there is a great paucity of them in the next. In North India mangoes were very cheap in 1933, but in the 1934 season the mango crop has been an almost complete failure. This kind of alternate fruiting is, however, also found in several other fruit trees, though perhaps not so well marked as in the mango.

An account of the floral morphology of the Philippine varieties of the mango has recently been given by Juliano and Cuevas.* The present study† which was started more than 10 years ago confirms their observations in a general way, but there are a few differences which are sufficiently noteworthy to be mentioned here. Some other points not mentioned by these authors are also dealt with briefly.

The Anther.—The development of the anther follows the usual course laid down for angiosperms, except that the sporogenous tissue is rather late in differentiating and is clearly distinguishable only after the walls are practically completed. There is an epidermis, endothecium, two middle layers and tapetum enclosing the mass of sporogenous cells within. At about the time of the first meiosis, the tapetal nuclei divide and the cells become binucleate. The reduction divisions in the microspore mother cells seem to go through in a normal way. The nuclear cavity is about 10 microns in diameter at the time of the greatest enlargement and

* *Philippine Agriculturist*, 1932, **21**, 449–472.

† My teacher, the late Dr. Winfield Dudgeon of Allahabad, had started some work on the morphology of the mango in the year 1920. For various reasons this could not be brought to a finish, and after his unexpected death on December 26, 1932, all his slides and rough notes were forwarded to me by Mrs. Dudgeon with a request to complete the work.

the chromosome pairs at diakinesis are so small and so closely applied to the nuclear membrane and clumped together amongst themselves that exact counting became impossible. There are, however, approximately 26 (24-28) pairs of chromosomes. Wall formation is simultaneous and comes on after the second reduction division is completed.

The development of the male gametophyte follows the usual course. A minute lenticular generative cell is cut off at one end of the pollen grain, but it soon moves inward and divides to form 2 male nuclei. Here my observations differ from those of Juliano and Cuevas (1932) who report that the pollen grains are uninucleate at the time of shedding. This appears to me to be very doubtful. The real fact is that there are widespread degenerations in the anther at this stage and even in those pollen grains which develop further there is so much starch that the nuclei become obscured in a great majority of the cases.

The Carpel.—Comparable with the anther, the archesporil cell is so inconspicuous in the nucellus that it cannot be distinguished with certainty. Only after the wall cell has been cut off and has divided once or twice, is the megaspore mother cell enough larger than the surrounding cells to be identified distinctly. The wall cells soon undergo many divisions so that the megaspore mother cell becomes deeply placed in the nucellus.

So many of the mother cells degenerate that it was not possible for me to have a sufficiently close series of stages for the study of the development of the embryo sac. But from what I have seen of the few good preparations I possess, I have no doubt that the development proceeds in the normal way as reported by Juliano and Cuevas. The mature embryo sac has an egg, two synergids, three antipodal cells and two polar nuclei which fuse early. The fusion nucleus lies almost in contact with the egg.

Pollination and Fertilisation.—The flowers open in the afternoon and remain fresh-looking till next day. Then the sepals and petals become reflexed, gradually wither and drop off. Pollination seems to be insufficient, for the stigma is poorly developed and there is a large percentage of defective pollen. Insects, specially flies, visit the flowers, but pollination through gravity and wind is not excluded. As the air is dry enough pollen can merely drop on from the higher inflorescences to the lower.

Actual fertilisation has not been seen, but in several embryo sacs in which endosperm formation had begun, I could see a small nucleus lying close to the egg nucleus and in slightly later stages 2 nucleoli in the nucleus of the zygote.

Endosperm and Embryo.—The primary endosperm nucleus seems to divide at once after fertilisation. Free nuclear division continues and a peripheral layer of endosperm nuclei is formed in the rapidly enlarging embryo sac. The embryo shows a remarkable delay in development. There are evidences that, occasionally, the fusion nucleus may be fertilised but not the egg. This seems to explain the statement of Juliano and Cuevas that "Some pistils have been observed to enlarge without any seed within."

The first division of the zygote occurs very late. An ovule with a 3-celled embryo had over 950 endosperm nuclei—a record for delayed development of the embryo in angiosperms, so far as I know.

Further stages have not yet been observed and a fuller account will be published as soon as sufficient material has accumulated.

The British Polar Year Expedition to Fort Rae, N. W. Canada, 1932–33.

MR. J. M. STAGG, in a paper presented at the Aberdeen meeting of the British Association for the Advancement of Science, dealt with some results of the "intensive observations in Meteorology and such allied fields of investigation as terrestrial magnetism, aurora and atmospheric electricity." Upwards of forty countries co-operated in the world-wide organisation and probably "over sixty special stations and expeditions, many of them in high northern latitudes, participated in the general programme." An expedition of six men was sent by Britain to reoccupy the station at Fort Rae on the Great Slave Lake, N. W. Canada. "The reduction of the data brought home by the expedition is now in an advanced stage of preparation. But the work of adequate discussion and co-ordination with the data for all the other Polar Year Stations, will be a matter of several years."

Obituary.

Dr. C. A. Barber, C.I.E. (1860–1933).

WITH the passing away of Dr. Charles Alfred Barber in the February of 1933, the scientific world in general and the pioneers of scientific agriculture in India in particular, sustained an irreparable loss.

Born at Wynberg in South Africa in November 1860, he came to England in 1871 and received his early education at Bath. In his 18th year he took service in a bank at Liverpool; but the love of nature, which he had acquired in his early South African home, urged him on to science, with the result that in 1883 he went over to Germany where he came under the personal influence of such eminent botanists as Strasburger, Schmitz and Schimper. In his 24th year he returned to England getting himself definitely wedded to botany and was admitted as a scholar in Christ's College. He was appointed Superintendent of Agriculture in the Leeward Islands in 1891, but had to return to England in 1895 owing to the abolition of his post. It was in these Islands that he made his first acquaintance with the plant to which he was destined to devote the last and perhaps the most fruitful years of his valuable life—sugarcane.

Dr. Barber came out to India in 1898 to take up the dual appointment of Government Botanist, Madras, and Director of the Botanical Survey of South India on a five-year basis. During this period he did the pioneer work of exploring the heavy forests of the Presidency, where the black monkey was sometimes his sole food. The collections made resulted in a number of plants being named after him. It was during this period that he carried out an extensive series of investigations on the *haustoria* of the sandal and other plants which obtained for him the degree of Doctor of Science (Cambridge).

But work of an economic nature was soon to occupy his attention. In 1899 the Government of Madras was faced with a steadily shrinking area under sugarcanes in the Godavery delta on account of the prevalence of 'Serah' and Dr. Barber was put on to it. He replaced the canes in cultivation with disease-resistant varieties with the result that the area began to recover. These were days when the then Government Botanist of Madras represented a good bit of the activities of a department which was just then kicking itself into life—the Agricultural Department. These belonged to the pre-Curzon period when there was no properly organised Agricultural Department in the country.

Besides sugarcane, diseases of both pepper and groundnut came under his purview with the result that his work included that of both mycologist and entomologist. Along with the late Mr. Benson he was responsible for the selection of site of the present Agricultural College at Coimbatore and also for the design and equipment of the various laboratories at the Coimbatore Institute with the exception of those devoted to chemistry. Returning to Coimbatore in 1908 after a couple of years' furlough in England, he organised the teaching courses in botany at the Coimbatore Agricultural College and started preliminary work on the breeding of various crops such as cotton, gogu and groundnuts, largely with the idea of building up material for the teaching at the College.

When, as a result of the powerful advocacy of the then Hon'ble Pandit Madan Mohan Malaviya before the pre-reform Central Legislature of those days, the Central Government decided to found a Sugarcane Breeding Station for all India, the subject of our sketch, who was admirably suited for the post by his previous work both in the Leeward Islands and in the Madras Presidency, was naturally selected.

From the year 1912 to 1919 he held the post of Government Sugarcane Expert for all India but with headquarters at Coimbatore. He soon applied himself to the task with his usual energy and thoroughness with the result that the Indian canes got themselves grouped for the first time on a proper scientific basis. The fact that his classification, based on external morphological characters, has been largely confirmed by the later and more recently developed chromosome investigations of Dr. Bremer, bears testimony to Dr. Barber's skill and judgment both as Systematist and Morphologist. His keen systematic mind made him start a collection of the wild types of *Saccharum* at Coimbatore and he was the first to deliberately use *Saccharum spontaneum* for crossing with sugarcane. Coimbatore canes are now occupying over 50 per

cent. of the Indian cane area and are steadily winning for themselves considerable reputation in other countries as well, and Dr. Barber was the founder of a station which has brought forth such good results in the fullness of time. Government conferred on him the title of C.I.E. in 1918 and his contribution to Indian Agriculture was fittingly recognised by the award to him in 1931 of the first Maynard-Ganga Ram Prize. When he returned home in 1919 he did so loaded with honours and respected by his colleagues both at Coimbatore and in other parts of India.

No sketch of his life would be complete without a reference to his methods of work. He was accurate, thorough to minute details and systematic almost to a fault. Everything in and about him was orderly. It was this that enabled him to get through an enormous amount of work with what looked almost like ease. He was a good and swift writer, very guarded in his expressions, an expert photographer and an artist of a high order, his holidaying often consisting of painting pictures. He was an all-round athlete and one was surprised to see his play at the tennis court even after he had put 55 years of strenuous life behind him.

* * *

Madame Curie (1867-1934).

THE death of Madame Curie which took place in a hill sanatorium on July 4, has deprived the scientific world of a great investigator and her family of a loving relative. Her death was the result of a short illness which seems to have been due to constant exposures to radiations from radio-active bodies with which her whole life-work was connected. Madame Curie was for the last few years engaged in preparing a more powerful source of actinium: she has thus died in full harness, but leaves a capable daughter and son-in-law to carry on the good work. Her remains were interred at Sceaux by the side of her beloved husband in accordance with her last wishes.

Madame Curie was Polish by birth and her maiden name was Marie Sklodowska. She was born at Warsaw on the 7th of November 1867 and received her early education in that city. Her love of science was so strong that in spite of straitened finances she determined to complete her education at Paris. Here she entered as a student at the Sorbonne and came under the influence of M. Pierre Curie who was one of her Professors. The common interest of master and pupil in scientific discovery ripened into a closer sentiment and Marie Sklodowska became Madame Curie in 1895. Madame Curie was not only the helpmate of her husband in domestic affairs but shared his scientific work to such a degree that M. Curie was most anxious later on to give all the credit of their joint discoveries to his wife.

It is now a matter of history and common knowledge how she became interested in Becquerel's discovery of radio-activity in 1896 and assumed the dominating place in this science by her discovery of Polonium and later by the isolation of radium. When it is recalled that a ton of pitchblende yields a few milligrams of radium and that the separating of this small quantity of the precious element from the large mass of mineral was done mostly by Mme. Curie who was responsible for the chemical part of the joint investigations, we can appreciate the patience and love of pure investigation which contributed to her just fame.

The work was done under very unfavourable conditions in a building in their backyard and mountains of pitchblende were piled up in all the available space. All the extraordinary pains taken fructified when the discovery of radium brought her honours from the entire learned world. Even here she had to contend against the disabilities of her sex; people expected her to remain in the background and enjoy the honours due to her work through her husband. But M. Curie was insistent that she should be recognised through her own individuality and brought her to London in 1903 when he was requested to deliver a lecture before the Royal Institution on their new discovery. She was an applicant for a place in the Academy of Sciences at Paris some twenty years ago, and received an unusually large number of votes; yet dissent was expressed against the principle of admitting women and she did not find a place in that august body. She was so sensitive and modest that she did not renew her application when a change in the public outlook was sure to secure her admission. There was no lack of honours, however; she is the unique example of a person receiving the Nobel Prize twice—once for Physics in 1904 with Becquerel and M. Curie and again for

Chemistry in 1911. Other honours, too numerous to mention, were showered upon her. She was the first woman to become a Professor at the Sorbonne. She became the Director of the Radium Institute and continued till her death to direct a large mass of important original work. Her heart must have expanded with pride when her daughter Iréne Curie-Joliot repeated her own history as it were, and with her husband M. Joliot discovered the neutron and induced Radio-activity. In 1921 she visited the United States and received a gram of radium as a suitable present.

Madame Curie.

The importance of her discovery was such that it originated new branches of investigation in more than one department of science. Her discoveries were fundamentally responsible for the new developments in Physics and Chemistry; but a larger section of humanity will bless her for the benefit conferred by radium therapy. She volunteered during the War to place herself at the disposal of the Red Cross Society and personally superintended the radiological cars amidst the fighting armies.

She has done notable service to her native country, Poland, and to her adopted country, France and has served on numerous committees and commissions. The reconstruction of Poland after the War was a source of gratification to her. She was associated with H. A. Lorentz, Paul Painlevè and Albert Einstein in the International Committee of Intellectual Co-operation of the League of Nations, and interested

herself chiefly in the problems of the future of the human race—mass education and co-ordination of international scientific research.

In spite of the enviable position she occupied in the esteem of the world, she retained her serenity and simplicity to the last. The unfortunate death of her beloved husband M. Curie by a street accident in 1906 dealt her a blow from which she never perfectly recovered. Her noble and affectionate nature endeared her to all her friends. All those who came in contact with her were struck by the simplicity of her character and the penetrating quickness of her intellect. She will ever be remembered as one who by her personal example and eminence secured to womenkind a recognition of equality with men in all departments of life including scientific research. The present position of women is founded on the secure foundation of the greatness of such personalities as Madame Curie.

* * *

Dr. S. K. Mukerji, F.L.S. (1896-1934).

DR. SUSHIL KUMAR MUKERJI, F.L.S., Reader in Botany at the University of Lucknow, Honorary Secretary of the Indian Botanical Society, died at Lucknow on the 5th August 1934, after a brief illness following an operation for appendicitis. He was only in his thirty-ninth year at the time of his death. About the middle of July he returned from Calcutta with a pain in the abdomen which had persisted for several weeks. On the 30th July he underwent an operation but by then he had already contracted peritonitis, which was followed by serious complications. The end came within a week, although for several days he had shown a steady improvement, making a brave fight against heavy odds. This remarkable power of resistance and of physical and mental endurance was truly characteristic of the man. He was endowed with an iron constitution, indomitable courage and a fervent spiritual faith of which few but his intimate friends were aware.

Sushil was born at Nowgong in Central India in March 1896, the second son of B. Kali Taran Mukerji, who survives him. He lost his mother when he was in his early twenties. His grand-father, Chandrakanta Mukerji, was Dewan and Foreign Minister of Bijavar State. S. K. Mukerji received his early education at Allahabad. He took the degree of B.Sc. from Muir College in 1916, migrating to Lucknow for a post-graduate course in Botany at Canning College, where he took a master's degree in 1920. In 1918 he was appointed a demonstrator in biology at that college, then affiliated to the old University of Allahabad. In July 1921 when the residential University of Lucknow was inaugurated and the college passed under a new jurisdiction, he was appointed University demonstrator in Botany. From this position, during the few years that were left to him, he had forged for himself a career remarkable for its many-sided success.

In December 1921 he was promoted to a Lecturer's post, and in December 1927 he was appointed Reader. This was immediately after his return home from a couple of years' study leave in Europe.

It was during this visit abroad that Mukerji found perhaps his best opportunities for exercising his versatile and dynamic personality. While preparing, for his doctor's degree in London, a thesis which was approved in November 1927, he found time for varied activities of an academic and social character. As a research student at University College, he gave valued assistance to the organising committee for the Centenary Celebrations of the College held in 1927. He read original papers and gave popular lectures on this occasion (**9, 10**)* as well as before the Linnean Society (1926 and 1927, **6, 7, 12**) of which he had become a Fellow; before the British Ecological Society (Manchester, 1926, **5**) which he had joined as a member; and before the British Association (Leeds meeting, 1927, **11**) for which he was elected a member of the sectional committee for Botany and Forestry. The esteem in which he was held was marked in a graceful manner by the presentation to him, by the staff of University College, of a barograph on the eve of his departure from London.

Mukerji returned to Lucknow in December 1927 after tour of the Continent, full of enthusiasm for the future. As before he threw himself heart and soul into anything that he took up, whether it was botanical research or gardening, sport and travel, the University Training Corps, the olympic games, or advisory work on the committees and councils of the University, of the Provincial Government, of the Indian

* These numbers refer to the list given at the end.

Science Congress, of clubs and societies. His enthusiasm was contagious. He was like a live wire running through all the organisations in which he had a part.

A man of extraordinary energy and driving force, he possessed a degree of self-confidence which the achievements of his brief career amply justified. But in a sense he was also the victim of his own versatility; too many of his scientific papers, although of great value as original contributions, were never followed up to the stage of full publication. The result was that he was robbed of his due recognition as a scientist, and Indian Botany of much of the fruit of his labours. Nevertheless, there can be no doubt of his great ability as an ecologist and taxonomic botanist, as a teacher and as an organiser.

Dr. S. K. Mukerji, F.L.S.

Shortly before his death, the Executive Council of Lucknow University had appointed him a delegate to the International Congress of Soil Science, to be held at Oxford in the summer of 1935, under the auspices of the International Society of Soil Science. The soil relations of plants had become his favourite subject of research (**14, 15**) ever since his initiation at the hands of F. W. Oliver and E. J. Salisbury. His thesis for the London D.Sc. (**13**) which is now being published in the *Journal of Ecology* contains material of great interest concerning the autecology and distribution of *Mercurialis perennis*. Among other results, it showed the great importance of the hydrogen-ion-concentration of the soil as a factor in the growth and distribution of plants.

Latterly he had turned his attention to the causes of the high mortality observed among seedlings in nature (**24**). This is a subject of obvious importance in relation to the survival, the distribution and ultimately of the evolution of species during the natural struggle for existence. Here, again, he found that the soil factors, such as the carbonate content, water content, organic content and hydrogen-ion-concentration, exercise a decisive influence.

The ecology of fresh-water vegetation was a pet subject with Mukerji and one to which he frequently returned (**5, 17, 19, 20, 21**) after his first paper, read before the Calcutta Session of the Indian Science Congress (1921, **2**), on the biotic succession in the flora of the Dal Lake in Kashmir. He had also made detailed studies of the floristics and ecology of parts of the Satpura range (**3**), of the Vindhya mountains (**4**) and of Lucknow and its vicinity (**1**). He was a taxonomist of considerable experience. His knowledge of the flora of Lucknow and its environs was unrivalled. Latterly he was engaged preparing an illustrated local flora. Such a work would have been of the greatest value to students, specially in the United Provinces. The figures for Mukerji's projected work had been prepared several years ago but so far as I am aware, the text had not yet been written.

From numerous excursions in the valley and among the mountains of Kashmir, Mukerji had gained an extensive knowledge of the Kashmir flora (**17, 19**), especially of the Lacustrine vegetation of the Dal and the Manasbal. A few years ago the Yale University expedition to the Karakorum range led by the German geologist Hellmut de Terra, had made an important collection of fossil plants in the so-called Karewa beds of Kashmir. These strata (of which the surface layers are a favourite soil for the cultivation of saffron) are commonly regarded as representing the sediments laid down in an extensive lake which must have

covered nearly the whole valley during the glacial age, and of which the Wular, the Manasbal, the Dal and other modern lakes are the dwindling remnants. Dr. de Terra wrote to me asking whether I could suggest the name of an Indian botanist who could undertake the investigation of this valuable collection: he would have to be a taxonomist familiar with the modern flora of Kashmir, but at the same time capable of appreciating the problem from the viewpoint of the distribution of species as affected by climatic fluctuations during the geologically recent past. The problem could not have been entrusted to abler hands than those of my late colleague. His name was suggested. Dr. de Terra readily agreed. It was with this problem in hand that Mukerji had made special visits to Kashmir and to Calcutta during the last two years. Shortly before his illness he was spending a vacation in Calcutta, comparing the fossil leaves, fruits, etc., with those of modern species from Kashmir, preserved in the herbarium at the Royal Botanic Garden. From the notes he has left, it appears that he had made provisional identifications of most of the fossils as far as they seemed comparable with living species. But, alas, the work was cut short in this preliminary stage: it remains one of the unfinished monuments of a life of unusually varied activity.

Lastly, mention should also be made of Mukerji's interest in Indian medicinal plants (**16, 18**) and on forest utilisation (**11, 22**): subjects on which he had sound views, based upon study and experience gained during his travels in Kashmir,—that region of intense scientific interest, destined only to be explored and appreciated by sons of foreign soil.

The void that has been left at the University, of which he was such an active member for the last thirteen years, will be difficult to fill. He will be missed on many occasions, and by many who had learnt to respect him as a fellow-student, a colleague, a teacher, a sportsman, as a friend and even as an adversary. A born fighter, with a keen sense of justice, he was quickly roused to a temper whenever he suspected unfairness; and regardless of himself, he would champion a cause solely from a passion for fair play. His best friends had nicknamed him 'Mussolini', an epithet not altogether belied by his appearance when confronted in argument. But those who did not see eye to eye with him will be the first to admit that in the end he was always open to reason, and that his assertive temperament concealed a generous heart.

Such was the man whom we mourn to-day, snatched away in the prime of life from a career of high utility but of still higher promise in the service of science and society.

B. SAHNI.

LIST OF SCIENTIFIC PUBLICATIONS.

Dr. S. K. Mukerji: (1) A study of the floristics and ecology of Lucknow (*Proc. Indian Science Congress*, Calcutta, 1921, p. 185). (2) The Dal Lake (Kashmir): a study in biotic succession (*Proc. Indian Science Congress*, Calcutta, 1921, pp. 185-187). (3) Plant succession in the Satpura Range, near Pachmarhi, C.P. (*Proc. Indian Botanical Society*, **3**, 262). (4) Ecological studies of the vegetation of the Vindhyas (*Proc. Indian Botanical Society*, Lucknow, 1923; *Journal of the Indian Botanical Society*, **3**, 262). (5) The vegetation of the Dal Lake region of Kashmir (*Proc. British Ecological Society*, Manchester, June 1926). (6) The vegetation of Kashmir, a contribution to the ecology of the Kashmir Himalayas (*Proc. Linnean Society of London*, May 1926). (7) Geographical distribution of the genus *Mercurialis* (*Proc. Linnean Society of London*, October 1926). (8) A new variety of *Mercurialis perennis* in the British Flora (*Journal of Botany*, London, February 1927). (9) Habitat forms of *Mercurialis perennis* (*Proc. Centenary Celebrations of the University of London*, University College, June 1927). (10) Ramblings of a naturalist in Kashmir and Switzerland (*Proc. Centenary Celebrations of the University of London*, University College, 28th June 1927). (11) The forests of Kashmir (*Journal of Scientific Transactions*, British Association for the Advancement of Science, Leeds, 6th September 1927). (12) Biological relations of *Mercurialis perennis* (*Proc. Linnean Society of London*, 3rd Nov. 1927). (13) Autecology of *Mercurialis perennis* with special reference to the soil factors (Thesis approved for the degree of D.Sc. at London University, 1927). (14) Stratification of nitrates in natural soils of Lucknow in the form of Liesegang rings and the significance of this phenomenon in Agricultural practice (*Proc. Indian Science Congress*, Madras, 1929, pp. 251-252). (15) The Hydrogen-ion concentration of the soil as a factor of vital importance in governing the distribution and growth of plants (*Proc. Indian Science Congress*, Madras, 1929, p. 252). (16) The commercial plantation and exploitation of Indian medicinal plants and the need for the compilation of an Indian pharmacopœa (*Proc. Indian Science Congress*, Bangalore, 1932, p. 333). (Published in full by the Indian Press, Allahabad, 1930, pp. 1-12). (17) Bathymetrical survey of the Dal Lake of Kashmir, with special reference to the penetration of actinic rays to different depths of water and their effect on the incidence of vegetation (*Proc. Indian Science Congress*, Bangalore, 1932, pp. 328-329). (18) On the genus *Artemisia*: its species, varieties and ecads as

found in Kashmir (*Proc. Indian Science Congress*, Bangalore, 1932, p. 329). (19) On the distribution of fresh-water plants in India (*Proc. Indian Science Congress*, Patna, 1933, p. 321). (20) Invasion of *Eichhornia crassipes* in the interior of the United Provinces (*Proc. Indian Science Congress*, Patna, 1933, pp. 321-322). (21) Some observations on the anomalous distribution and ecology of *Nymphæa tetragona* Georgi (*Proc. Indian Science Congress*, Patna, 1933, p. 322). (22) The rôle of *Parrotia Jacquemontiana* Dcne, in the forest ecology of Kashmir State (*Proc. Indian Science Congress*, Patna, 1933, p. 322).

S. K. Mukerji and T. C. N. Singh: (23) On the adaptation of some perennial plants of the Lucknow flora to the marked periodicity of the climate (*Proc. Indian Botanical Society*, Lucknow, 1923; *Journal of the Indian Botanical Society*, **3**, p. 262).

S. K. Mukerji, S. C. Verma and S. N. Asthana: (24) On the ecological investigation of twelve different kinds of seedlings belonging to ten families of flowering plants from the Lucknow flora with a view to find the causes of excessive seedling mortality in nature (*Proc. Indian Science Congress*, Bangalore, 1932, pp. 329-330).

Letters to the Editor.

Changes in Charge, Conductivity, Stability and Composition of Colloidal Arsenious Sulphide on Exposure to Light.

IT is known that arsenious sulphide sol when exposed to light becomes turbid and its flocculation value by electrolytes is lowered.[1] In our laboratory we have made simultaneous measurements of charge, conductivity, stability and composition of aresenious sulphide sol when exposed to electric light for different periods. It is observed that the charge on the colloidal particles continuously decreases while the conductivity of the sol increases with an increase in the period of exposure to light; the amount of free arsenious acid in the sol at the same time increases (the amount of total arsenic remaining the same) while the amount of total sulphur decreases somewhat. The stability of the sol as determined by flocculation values with KCl first increases and then decreases;[2] on the other hand, when $MgCl_2$ is used to coagulate the sol, the stability is found to decrease continuously.

The arsenious sulphide sol when exposed to light hydrolyses as on ageing into arsenious acid and hydrogen sulphide; the latter is photochemically oxidised to sulphur dioxide which again reacts with hydrogen sulphide to form pentathionic acid and sulphur. The sulphur adsorbs polythionate ions and passes into colloidal sulphur.[3] The decrease of the cataphoretic speed (charge) noticed by us is due to an increase of the amount of free arsenious acid in the sol produced as a result of hydrolysis of arsenious sulphide[4]. The increase of conductivity is on account of the production of free arsenious acid due to hydrolysis and of polythionic acids as a result of photochemical oxidation of hydrogen sulphide[5]. The smaller stability of the sol is due to a decrease of the charge on the colloidal particles, but the greater stability observed with KCl when the sol is exposed to light only for short periods cannot be explained on the same basis because the charge on the colloidal particles has continuously decreased; this anomaly with regard to KCl is being investigated. The fact that the total amount of sulphur in the sol decreases somewhat on exposing it to light is due to some hydrogen sulphide escaping as gas from the sol. Details of experiments and results will be published elsewhere in due course.

C. B. JOSHI.
P. M. BARVE.
B. N. DESAI.

Physical Chemistry Laboratory,
Wilson College,
Bombay 7,
August 3, 1934.

[1] Freundlich and Nathanschn, *Kolloid Zeit.*, 1921, **28**, 258.

[2] *Cf.* Miss Sheila Roy, *J. Ind. Chem. Soc.*, 1929, **6**, 431.

[3] Freundlich and Nathansohn, *loc. cit.*

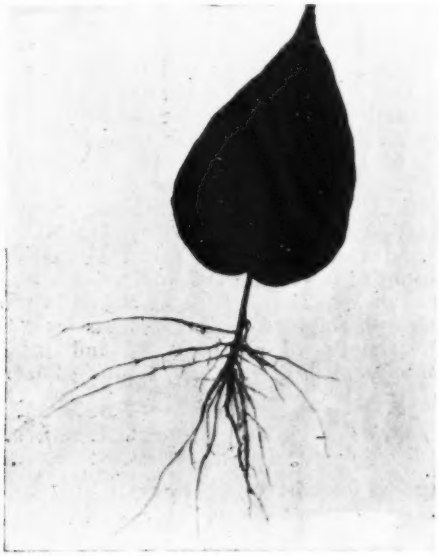
[4] *Cf.* Desai, *Curr. Sci.*, 1934, **2**, 473.

[5] *Cf.* Murphy and Mathews, *J. Amer. Chem. Soc.*, 1923, **45**, 16.

Development of Roots from the Petiole of *Ficus religiosa* Leaf.

WHILE investigating the influence of external environmental condition (*e.g.*, factors like light, temperature, humidity, etc.) on the formation of cuticle in *Ficus religiosa*, I had an occasion to pluck some

of the leaves from the lower region of the shoot, which appeared to obstruct the fitting up of the apparatus. On the same day (17th July 1934) those plucked leaves were placed in tap water. The cuticle experiment was conducted for a fortnight. During this period the leaves remained in the same water. They did not show any sign of senescence. The leaves were examined on 31st July 1934 to find a possible cause of their remaining healthy, when some root-like structures were found to come out from the callus formed at the base of the petiole. On closer examination they were seen to be real roots with root-hairs and root-caps. On 2nd August 1934, the leaves were placed in fresh tap water, to see if any further change would take place. After a couple of days the first-



formed roots elongated and had developed root-hairs profusely. On 4th August 1934, one of the leaves with roots was placed in moist sand to see if any shoot would come out. This leaf remained healthy for 3 days, but from 7th August 1934, it began to show signs of decay. The other leaf in the meantime had borne several roots right from the severed surface up to the middle portion of the petiole. On the same date this was placed in very dilute nutrient solution (Pfeffer's). The roots elongated and fresh root-hairs came out from the elongated parts. Some roots gave out branches and the length of the individuals became gradually greater.

The leaf is quite healthy and is living till this day (17th August 1934) when the article is being sent to the press. But no shoot is coming out.

Further work on this is proceeding.

P. F. MALLIK.

Ravenshaw College,
Cuttack,
August 17, 1934.

Note on the Theory of Artificial Disintegration.

IN a recent publication[1] I (in collaboration with A. Ganguli) have given the following wave statistical formula for artificial disintegration of nucleus by α-particles.

$$\lambda = C.\frac{\sqrt{E_1 E_2}}{h^2 r_{01}^2 r_{02}^2 \operatorname{Cot}\mu_{01} \operatorname{Cot}\mu_{02}} \times \quad .. \quad (1)$$

$$\times \exp.-\{2k_1(2u_{01}-\operatorname{Sin} 2u_{01})-2k_2(2u_{02}-\operatorname{Sin} 2u_{02})\}$$

where the suffixes 1 and 2 are respectively for the bombarding α-particles and the disintegrating protons. The above formula has been shown to be in good agreement with experiment. The discontinuities in the curve lately found by Chadwick and others[2] can be explained from the above formula on assuming the existence of different groups of protons within the nucleus. Investigation in this direction has already been taken up by M. Ghosh. It should also be noted that the above formula is perfectly general and may be used for any other class of nuclear artificial disintegration.

Since the paper has been published, my attention is drawn to a recent article on the subject by Th. Sexl.[3] After elaborate analyses Sexl finds that the absorption coefficient (a) for the α-particles is given by (in the present notation).

$$a \sim e^{-2k_1(2u_{01}-\operatorname{Sin} 2u_{01})} \quad .. \quad (2)$$

Since $\lambda \propto a$, formula (2) obviously corresponds to the first part of my formula (1), which follows directly from the assumption of a viscous phase space for the nucleus.

We should also note that the second part of equation (1) representing the disintegrating protons is taken with a positive sign in the

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[1] *Curr. Sci.*, 1934, **2**, 471.
[2] *Proc. Roy. Soc.*, **130**, 463; **135**, 48.
[3] *Zeit. f. Phy.*, 1934, **87**, 105.

exponential, whereas in the case of spontaneous disintegration the sign is negative. The solution of the relevant differential equation gives both the signs.[4] As usual we are to fix the sign from a physical consideration of the problem. From the principle of conservation of energy we find that for a given velocity of the bombarding α-particle the number of protons coming out of the nucleus with a higher velocity is less. So the sign must be taken positive. Conditions are, however, different when the emission is spontaneous.

Lastly, we may remark that in his above treatment Sexl appears to think that when the limit of approach of the bombarding α-particle is zero, there is usual Rutherford scattering but if, instead, the limit is r_0 there is an additional term in the perturbation function which represents disintegration. But after Mukherjee's well-known wave statistical theory[5] of anomalous α-scattering based on the assumption of a critical radius r_0, the above idea of Sexl should, I think, be discarded.

K. C. KAR.

Physical Research Laboratory,
Presidency College,
Calcutta,
August 28, 1934.

Determination of e/m and Mass of Individual Charged Particles in Colloids.

IT is of great interest to determine the size and mass of *individual* particles in colloids, as the methods hitherto employed give only the *average* values, which are more or less incorrect. I have therefore been working out different methods for the determination of the mass, size and the ratio of the charge to mass of *individual* particles in colloids. One of these has been briefly mentioned in a previous note.* A short account of another method which has been worked out successfully by me is given below :—

The colloid under examination was contained in a cataphoresis cell, which was so fixed in the ultramicroscope that, when an electric field was applied across the electrodes, the colloidal particles moved up or down depending on the direction of the field. The eye-piece was fitted with a micrometer scale. Any single particle was selected in the field of view of the ultramicroscope. Then an electric field of 80 or 100 volts was applied across the electrodes and the velocity (v_1) of the motion of the single particle in a vertically *downward* direction, *i.e.*, under the combined influence of the electric and gravitational fields, was found. The electric field was then reversed, and the velocity (v_2) of the movement of the same particle in a vertically *upward* direction with the force of gravity acting against the electric field was found. Then we have

$$\frac{V_1}{V_2}=\frac{Xe+4/3\pi r^3 (d_1-d_2)\,g}{Xe-4/3\pi r^3 (d_1-d_2)\,g}; \quad \text{or} \quad \frac{V_1+V_2}{V_1-V_2}=\frac{Xe}{m.g.c}$$

(X is the applied electric field, e the charge of the particle, m its mass, g the gravity constant, d_1 and d_2 the densities of the particle and the medium respectively). X, g and c are constants, the values of which are known. Knowing further the values of V_1 and V_2, which have been determined experimentally, the value of e/m for each individual colloidal particle observed in the field of the ultramicroscope could be calculated.

Comparison of the values of e/m for several particles has shown that the value of e/m for a certain set of particles is practically the same, that for others a simple multiple of the former, and so on. It is, however, necessary to work with a large number of such particles before a generalisation can be made. I am therefore continuing this investigation and extending it to a number of colloidal systems.

K. KRISHNAMURTI.

College of Science,
Nagpur,
August 29, 1934.

The Development of the Female Gametophyte of *Ludwigia parviflora*, Roxb. and *Jussieua repens*, Linn.

THE family Onagraceæ has long been of interest to the morphologist and cytologist. The added importance given to it by the series of papers recently published by Dr. Donald A. Johansen of the Stanford University, has prompted us to give here a brief report of our own observations on the development of the embryo sac in two plants of this family, which we had the occasion to collect in our trips to places near about Agra.

[4] *Vide* solution by Riccatti's method given by Sexl, *Zeit. f. Phys.*, 1929, **56**, 92.

[5] *Phys. Zeit.*, 1933, **34**, 175.

* *Curr. Sci.*, 1934. **2**, p. 387.

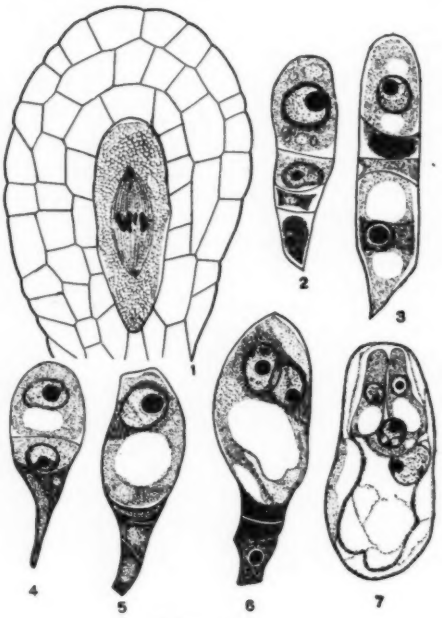
Both the plants are found only in marshy habitats, but the second—*Jussieua repens*—thrives best in water. The ovary is completely inferior, four to five-celled, and has rows of numerous tiny ovules arranged on the axile placentas. In *Jussieua repens* two leaf-like appendages are present on the ovary which do not, however, give a clear indication of the presence of xylem and phloem.

The ovules are anatropous and since there is a gradation in their rate of development, a fair number of stages can be obtained from a single ovary if suitably cut. In later stages the ovules become bent and pressed towards the central axis—an arrangement evidently designed to facilitate the entry of the pollen tube. In *Jussieua* the curvature of the ovules continues till they become completely curved over with the micropyle pointing upward. In *Ludwigia* there is no uniformity, but the longitudinal axis of the ovule usually lies at right angles to the placenta with the micropyle turned inwards. There are two integuments, but the outer is not developed towards the side of the funiculus. Neither a hypostate nor epistase develops in any of the two species.

Usually there is a single hypodermal archesporial cell, but the adjoining cells of the nucellus sometimes resemble this so closely that it is difficult to distinguish it clearly from them. The primary wall cell in *Jussieua* gives rise to an extensive parietal tissue, but in *Ludwigia* only two layers are formed in most cases. Occasionally the epidermal cells of the nucellus also divide at certain points in *Jussieua*.

The megaspore mother cell (Fig. 1) gives rise to a tetrad of four megaspores which are usually arranged in a single row, but in *Ludwigia* it occasionally happens that the cell-wall laid down in the chalazal dyad is oblique (Fig. 4) or even perpendicular in the latter case the megaspores become arranged in the form of an inverted "T". In *Jussieua* two tetrads are occasionally present in the same nucellus.

The micropylar megaspore alone functions in most cases, but the chalazal often enlarges considerably and both may continue to grow for some time (Fig. 3). More rarely the upper two may enlarge and the two at the chalazal end may be the first to degenerate (Figs. 2 & 4). In most cases the remains of the three degenerating megaspores can be easily made out in both genera even up to the time the embryo sacs are ready for fertilisation.



Figs. 1-7.

All figures are of *Ludwigia parviflora* and have been reproduced at a magnification of ×625.

During the enlargement of the micropylar megaspore a vacuole appears at its lower end so that the nucleus always lies at the top (Fig. 5). Here it undergoes two divisions giving rise to 4 nuclei (Figs. 6 & 7) of which three take part in the formation of the egg apparatus and the fourth functions as the single polar nucleus. As in the other Onagraceæ, so far investigated (except *Trapa*) there are no antipodals nor a lower polar nucleus.

Sterility of ovules was common in both the plants. In *Ludwigia* several cases were seen where both the nucellus and embryo sac were absent and only the integuments were left. Degenerations might set in at any stage, but are more frequent in later stages.

P. MAHESHWARI.
BABU LAL GUPTA.

Agra College,
Agra,
August 31, 1934.

A Case of Ovoviviparousness in Adult Gall Midges (*Itonididæ*).

KHALE[1] first recorded the remarkable phenomenon of ovoviviparousness in gall midge larvæ. Later Felt[2] described this type of pædogenesis in the genera *Miastor* Mein, and *Oligarces* Mein. But the only reference in the literature to this habit in the adult gall midges is by Cotes[3], who records that Wood-Mason believed the "silver-shoot" gall midge of paddy *Pachydiplosis oryzæ* Wood-Mason, to be viviparous.

While recently working on the Indian forms of this family, I came across an undoubted case of this habit in the adults of a new species[4]. The abdomen of a female of this species was observed to be heavily loaded with numerous cylindrical, apodous larvæ, which were at first believed to be those of Hymenopterous parasites. Subsequent observations, however, proved to the contrary and it was found that they were true Itonid larvæ, hatched from eggs inside the abdomen of the mother.

After pairing of the midges, the eggs are fertilised but are not deposited by the female. The larvæ are hatched from them, retained and nourished in the abdominal cavity of the parent midge. Living maggots are then deposited after twelve days on decaying vegetable matter. When freshly extruded they are about 1 mm. long and yellowish-white in colour. Some of them are already in a far-advanced stage of development and immediately turn into pupæ. Others, however, feed on the decaying vegetable matter and pupate after a further period of development extending over a month. The adults emerge in about five days.

This habit seems to be of great advantage to the species in two ways. Not being so helpless as eggs, the larvæ have a chance of escaping parasitisation. When sufficient food is lacking, some at least of the larvæ, already well developed, can immediately pupate after being laid and turn into adults, thus providing against the entire extinction of the generation.

M. S. MANI.

Entomological Section,
Zoological Survey of India,
Indian Museum,
Calcutta,
September 1, 1934.

[1] Khale, W., "Die Paedogenesis der Cecidomyiden," *Zoologica*, 1908, **55**, 21, 1-80.

[2] Felt, E. P., "*Miastor americana* Felt, an account of Pedogenesis," *Bull. N. Y. St. Mus.*, 1911, No. 147, 82-104.

"Biology of *Miastor* and *Oligarces*," *Science*, 1912, **33**, 278-280.

[3] Cotes, E. C. "Notes on Indian Economic Insects," *Ind. Mus. Notes*, 1890, **1**, 103.

[4] This new species is described in a paper shortly to appear in the Records of the Indian Museum under the name *Thurauia chilkaensis*, sp. nov.

Exembryonate Seeds.

IN their interesting note recently published Joshi and Rao[1] record the formation, in *Tinospora cordifolia*, of fruits and seeds which are outwardly normal although devoid of all trace of an embryo. There is no evidence of fertilisation, indeed, even of pollination; the egg-apparatus and antipodal cells of the otherwise normal embryo-sac degenerate early, but a copious endosperm results from the fusion of the two polar nuclei; there is, of course, no triple fusion. The ovary ripens into a healthy, fleshy fruit, containing seeds which are normal except for the absence of an embryo.

The authors suggest a comparison with the case of *Cycas revoluta* recorded by Kashyap in 1921, where foreign pollen may possibly provide the necessary stimulus to the further development of the ovule[2]. But they do not refer to an important paper published earlier, in which le Goc[3] proved the influence of foreign pollen on the development of the ovule of *C. Rumphii*. In the *Tinospora*, however, there is no question even of foreign pollen. A palæbotanist is at once reminded of the fact that so many of the best preserved palæozoic gymnosperm "seeds" are totally devoid of an embryo. This fact has generally been explained on the analogy of the modern *Ginkgo*, where fertilisation is said to take place after the ovule has fallen to the ground. No such explanation will, however, apply in the present case.

But how does the *Tinospora* seed *germinate*, if at all? Whence does the *seedling* take its birth? These are obvious questions on which, it is a pity, the authors are silent. Does the endosperm itself function here as an embryo? It has been

[1] *Curr. Sci.*, 1934, **3**, 2, 62.

[2] Kashyap, *Journ. Ind. Bot. Soc.*, 1921, **2**, 120.

[3] le Goc, *Ann. Roy. Bot. Gard. Peradeniya*, 1917, **6**, 3, 187.

suggested, rather acutely, that the endosperm of the higher flowering plants is in its morphological nature a sort of embryo. No doubt the authors will pursue their enquiry, in due course, into these matters.

B. SAHNI.

The University,
Lucknow,
September 2, 1934.

On the Development of the Dorsal Arcualia in the Cervical Vertebra in Chelonia.

PREVIOUS workers[1-5] on the development of the vertebral column of Chelonia, have stated that the dorsal arcualia of the cervical vertebræ are formed from the cartilaginous basidorsals of either side to complete the neural arch. But our recent investigation disproves their findings. Mookerjee[6] has shown that in the vertebral column of Urodela the cartilaginous basidorsals of the corresponding vertebræ are situated at the middle region of the centrum. There is a third piece of cartilage, the supradorsal, which intervenes between the basidorsals of either side and leads to the completion of the cartilaginous arch. Besides this, at the anterior and posterior portions of this cartilaginous arch, there are two connective tissue arches which complete the dorsal arcualia of each vertebra. These connective tissue arches become osseous without going through the stage of chondrification, and they are thinner in cross-section than the cartilaginous basidorsals mentioned above. An identical condition, as detailed above, has been shown recently by Mookerjee in collaboration with Chatterjee[7] in the vertebral column of snakes. Now a similar condition has again been observed by us in the vertebral column of Chelonia (Figs. 1-5).

It may further be pointed out that in the intervertebral region of *Chrysemys* structures like the zygosphenes and zygantra or the fibrous tissue, characteristics respectively of snakes and newts[7] are not found; but the intervertebral region of *Chrysemys* comes closer to the anuran condition in as much as

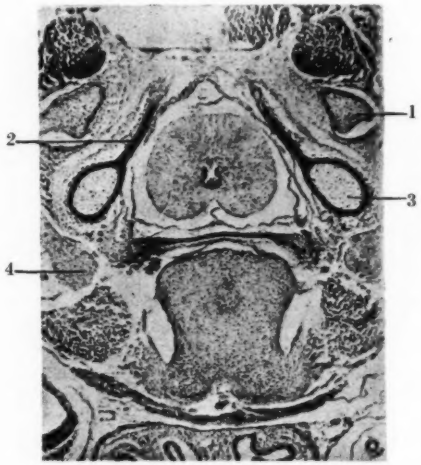


Fig. 1. ×40

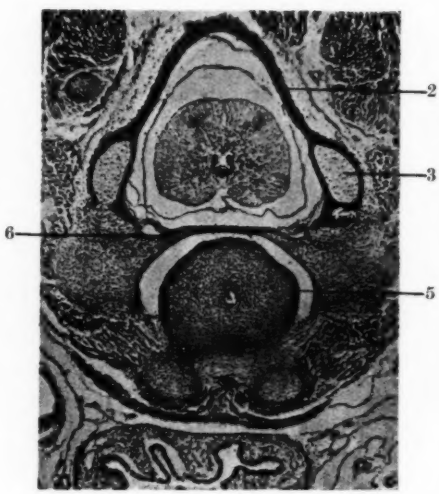


Fig. 2. ×42·5

a big gap exists between the two successive vertebræ.

Mention may also be made here of the fact that in the second vertebra of *Chrysemys*

[1] Gegenbaur, C., *Untersuchungen zur vergleichenden Anatomie der Wirbelsaule bei Amphibien und Reptilien*, Leipzig, 1862.

[2] Hoffmann, C. K., *Bronn's Klassen unf Ordnungen des Tierreichs*, 1890, Bd. VI, Abt. 3.

[3] Gadow, H., *Phil. Trans. Roy. Soc.*, 1896, **187 B.**

[4] Gadow, H., *The Evolution of the Vertebral Column*, Cambridge, 1933.

[5] Procter, J. B., *Proc. Zool. Soc. London*, 1922.

[6] Mookerjee, H. K, *Phil. Trans. Roy. Soc.*, 1930, **218 B.**

[7] Mookerjee, H. K., and Chatterjee, B. K., *Curr. Sci.*, 1934, **2**, 434-436.

there is a dorsal spine, which is an outgrowth at the mid-dorsal region of the anterior connective tissue arch. This could not, however, be found in other cervical vertebræ.

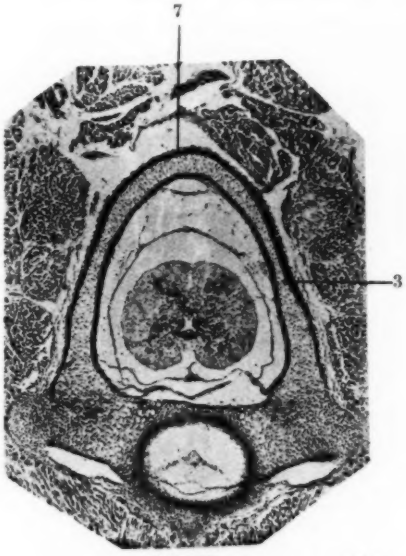


Fig. 3. ×36

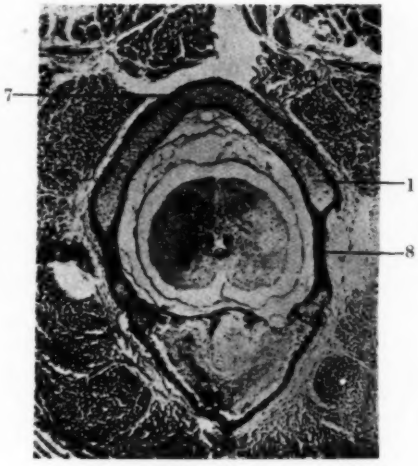


Fig. 4. ×46

For the sake of comparison we have given the side view of two consecutive adult cervical vertebræ (Fig. 6) and have marked those planes through which the transverse sections would have passed. Figs. 1 to 5 correspond more or less with the markings on the adult vertebræ.

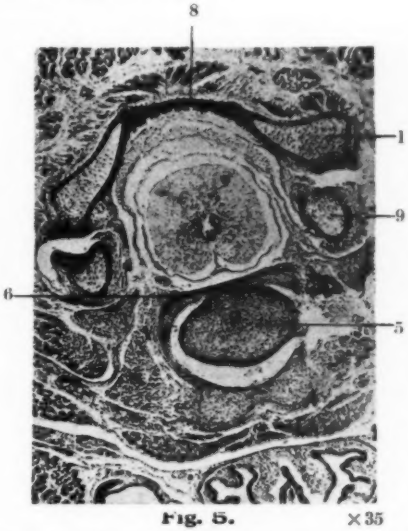


Fig. 5. ×35

Figs. 1—5. Serial transverse sections through different regions of a cervical vertebra of *Chrysemys marginata* at 15 mm.

1. *Postzygapophysis.*
2. *Anterior connective tissue arch.*
3. *Cartilaginous basidorsal.*
4. *Spinal nerve ganglion.*
5. *Condyle of the vertebra.*
6. *Socket of the vertebra.*
7. *Supradorsal.*
8. *Posterior connective tissue arch.*
9. *Prezygapophysis.*

Fig. 6. ×11

Side view of two consecutive adult cervical vertebra of *Chrysemys marginata.*

a, *b*, *c*, *d* and *e* are the planes through which Figs. 1 to 5 have passed.

HIMADRI KUMAR MOOKERJEE.
AMAL KRISHNA MUKHERJEE.

Department of Zoology,
University of Calcutta,
September 4, 1934.

An Automatic Device for Maintaining Constant Pressure.

WHILE developing a new type of pendulum oscillating in an evacuated chamber, considerable difficulty has been experienced in maintaining the required pressure of about 1 mm. of Hg. Due to the large size of the chamber and the numerous joints involved in the construction, a small leak was unavoidable. An automatic arrangement was therefore developed and found to maintain the pressure inside the chamber constant to within ± 0·5 mm. of mercury. The platinum electrodes K_1 and K_2 are fused into a manometer as shown in Fig. 1. K_1 is in permanent contact with mercury while K_2 is at some height determined by the desired pressure in the chamber. As soon as a leak develops, the mercury rises in the manometer and completes the circuit of the relay R which switches on the motor; the latter runs till the pressure in the chamber falls to the previous value. It might at first appear that, once the motor has started, it will stop almost immediately (due to the rapid fall of the mercury column in the manometer) resulting in jerky operation. But owing to capillary attraction, the surface of mercury remains in contact with the platinum point for an appreciable length of time, thus ensuring smooth performance. On one occasion, the motor was switched on once every 40 minutes and was kept running each time for 20 seconds.

If a larger variation of pressure is permissible the adaptation of a thermal time delay device in the relay circuit further smoothens the operation by keeping the motor running for some time after the manometer contact breaks.

The time delay device (Fig. 2) consists of a compound strip of brass and iron, rivetted together. After insulating the strip with asbestos paper a few turns of nichrome wire are wound over it. The rate of heating, the size of the strip and the heat insulation determine the period of delay. The compound strip on being heated by the current switched on by the manometer relay, bends and switches on the motor. Even though the mercury column in the manometer breaks the heater current, the contact is maintained a little longer owing to the heat capacity of the strip. A strip of 4 cm. ×

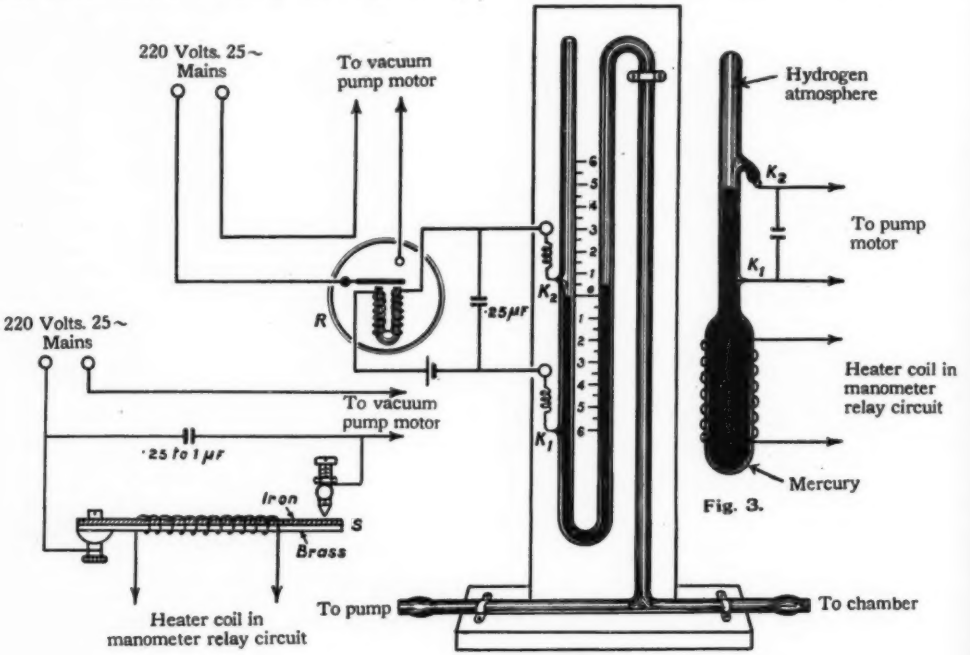


Fig. 2.

Fig. 1.

Fig. 3.

1 cm. × 0·1 cm. wound with 20 turns of No. 30 nichrome wire is found to give a time delay of 2 minutes.

A more satisfactory time delay arrangement is a thermally-operated mercury switch as shown in Fig. 3. This arrangement permits greater flexibility. The size of the bulb, the bore of the strip and the rate of heating determine the period of contact and can be adopted to individual requirements within wide limits. The atmosphere of hydrogen prevents heavy sparking and fouling of the contact surfaces.

C. CHANDRASEKHARIAH.

Elecl. Communication Laboratories,
Indian Institute of Science,
Bangalore, *September* 5, 1934.

Influence of High Temperature on the Raman Bands of Benzene.

FUJIOKA[1] studied the Raman spectra of a few organic liquids at 10°C and at 100°C and found that in the case of benzene the two Raman lines 1584 cm.$^{-1}$ and 1603 cm.$^{-1}$ are remarkably broadened at 100°C and generally those lines which are diffuse at room temperature become slightly broader at 100°C. He attributed this broadening of the diffuse lines with rise of temperature to the increase of rotation of the molecules. Since comprehensive theories about the structure of the Raman bands have subsequently been put forward by Placzek[2] and Placzek and Teller[3] it is easy to understand now the changes which the Raman lines may undergo with rise of temperature. The Raman spectrum of benzene has therefore been investigated more carefully at different temperatures in the range 35°C to 160°C. The microphotometric records of the Raman spectra of benzene at 35°C and 160°C are reproduced in Fig. 1.

A comparison of the Raman spectra of hot and cold benzene shows that many of the lines undergo changes at high temperatures. The lines 1584 cm.$^{-1}$ and 1603 cm.$^{-1}$ are found to become broader at high temperatures as observed by Fujioka. Besides this, the following changes not reported by Fujioka are also observed. The Raman line 603 cm.$^{-1}$ excited by both the mercury lines 4046 Å and 4358 Å, though fairly sharp at the room temperature, becomes much broader at high temperatures. The band 3047 cm.$^{-1}$ excited by 4358 Å not only becomes broader but also its intensity diminishes at high temperatures. The line 1180 cm.$^{-1}$ excited by 4358 Å seems at first sight to be broadened very much but the same line excited by 4046 Å does not undergo much change with the rise of temperature. On closer examination it is found that the Raman band 2945 cm.$^{-1}$ excited by 4046 Å is just superposed on the line 1180 cm.$^{-1}$ excited by 4358 Å and is very feeble at the room temperature but its intensity as well as the width increase with the rise of temperature so that at high temperatures the line 1180 cm.$^{-1}$ is masked by it. Thus it is the line 2945 cm.$^{-1}$ which undergoes the change and not the line 1180 cm.$^{-1}$ The lines 3047 cm.$^{-1}$ and 2945 cm.$^{-1}$ seem to be intimately connected to each other, because as the intensity of the former diminishes with the rise of temperature that of the latter increases. This change in the relative intensities of the Raman lines with the change in the temperature is different from that predicted by Placzek's theory, because the latter change can take place only in the case of lines of small frequency shifts. The influence of higher rotational and vibrational states seems to bring about a slight deformation of the molecule, so that the change in the polarisability in the case of one of the vibrations diminishes while that in the other case increases. The only other change observed at high temperatures is the usual increase in the intensity of the anti-Stokes line 990 cm.$^{-1}$ The width of the lines 990 cm.$^{-1}$ and 3060 cm.$^{-1}$ does not change with the rise of temperature.

The observed increase in the width of the line 603 cm.$^{-1}$ with the rise of temperature may be due to anharmonicity, because the vibration frequency being low, it is possible for a considerable fraction of the molecules to possess initially a vibration quantum number greater than zero, and according to the theory, the width of the line in the case of anharmonic vibrations depends slightly on the initial quantum number v_1. In the case of the lines 2945 cm.$^{-1}$ and 3047 cm.$^{-1}$, however, the frequencies being great, the observed broadening cannot be due to anharmonicity. Theoretically, if the vibrations are not total symmetric but cause a degradation of the symmetry of the molecule, the whole

[1] Y. Fujioka, *Sc. Pap. Inst. Phys. Chem. Res. Tokyo*, 1929, **11**, 205.
[2] G. Placzek, *Zeit. f. Phys.*, 1931, **70**, 84.
[3] G. Placzek and E. Teller, *Zeit. f. Phys.*, 1933, **81**, 209.

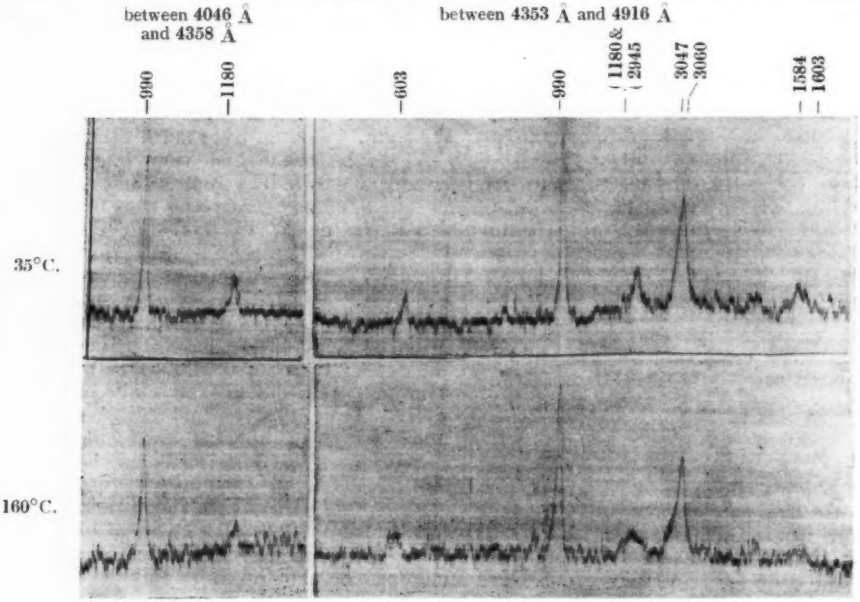


Fig. 1.

intensity of the corresponding Raman lines is due to anisotropic scattering depending on the orientation of the molecule. Such a Raman band possesses a structure consisting of ten branches. The frequency shifts of these branches from the centre of the band depends on J and K, where J and K are the quantum numbers of the total rotation impulse and that along the axis of the molecule respectively. The probability of higher values of J and K increases with the rise of temperature and consequently the width of the band also increases.

It is easy to understand why the width of the lines 990 cm.$^{-1}$ and 3060 cm.$^{-1}$ does not increase with the rise of temperature. These lines being due to total symmetric oscillations the intensities of the central lines are due to "spur" scattering, *i.e.*, scattering contributed by the diagonal sum of the matrix elements of the tensor representing the change of polarisability. Such a scattering is independent of the rotation of the molecules. There is, however, an accompanying rotational wing, but it is as feeble in comparison with the central sharp line as the wing accompanying the Rayleigh line is in comparison with Rayleigh line itself.

The author's thanks are due to Prof. D. M. Bose for his kind interest in the work.

S. C. SIRKAR.

University College of Science,
92, Upper Circular Road,
Calcutta,
September 6, 1934.

Lilac Ortho-Pyroxenes from Koratagere (Mysore State).

AMONG the outcrops which form the suite of Cordierite-hypersthene rocks near Bidaloti (Lat. 13° 31′ N.; Long. 77° 17′ 30″ E.) in Koratagere taluk, are a few which show a peculiar violet or lilac ortho-pyroxene. This is the first instance in which such a type of ortho-pyroxene has been noticed in Mysore and so far as we are aware, its occurrence has not been recorded elsewhere either. In microsections the mineral shows the usual characteristics of hypersthene, *i.e.*, straight extinction, negative sign and pleochroism but differs from it in having a lower refractive index, a lesser intensity of pleochroism and a different scheme of axial colours as noted below:

X = yellow.
Z = Y = lilac to lavender.

The mineral is closely associated with the normal pink to green pleochroic hypersthene, cordierite and biotite, and it is probably a derived species from the reconstruction of the altered products of the latter two minerals. Detailed investigations regarding its optical and chemical characters, etc., are being carried on and the results obtained will be published elsewhere in due course.

B. RAMA RAO.
M. B. RAMACHANDRA RAU.

Mysore Geological Dept.,
Bangalore,
September 7, 1934.

The Open Pan System of White Sugar Manufacture.

IN the note published in the July issue (p. 24) of *Current Science* Dr. Iyengar was somewhat unkind to the growing industry, having perhaps overlooked the extreme limitations of the modern factory system. In view of our unique agricultural and market conditions, the ultimate scope of the vacuum plants may be estimated at 15 per cent. of the total sugar produce of the country; whereas the open pan system, the output of which already equals that of the large centrals, has a fair chance of superseding the primitive methods of *gur* manufacture, if further technical development is forthcoming.

Dr. Iyengar's figures relating to low sucrose recovery by the open pan process curiously fail to discourage the average *Khandsari* which, with simple equipment, turns out 5 per cent. white sugar and 6 per cent. *gur* of marketable quality as against Indian factory averages of 5 per cent. first sugar, 4 per cent. inferior grades and 4-5 per cent. waste as molasses. Nor does the comparatively inefficient milling, which yields about 15 per cent. less juice than the elaborate tandem of the factory, constitute an entire disadvantage as the absence of the additional impurities that would result from multiple crushing serves to render the by-product edible.

Open pan boiling *per se* is not an unsound proposition, if it is recognised that one of the most expensive complications of the modern central, *viz.*, vacuum evaporation, although desirable on economic grounds when dealing with several hundreds of tons of juices daily, can be dispensed with by the small manufacturer with little appreciable damage to the juices. In fact, up-to-date factories in Europe evaporate beet juices under *pressure*, the issuing vapours serving as process steam for auxiliary purposes.

The possibilities of the open pan process cannot be gainsaid, as further investigations might lead to the evolution of a cheap manufacturing unit yielding with minimum waste, a product that might satisfy non-fastidious consumers and serving the interests, needs and limitations of the agricultural classes as no expansion of the modern factory system can.

L. GOPALA RAO.

Indian Institute of Science,
Bangalore,
September 11, 1934.

I AM not in the least unkind to the open pan industry but am simply looking at hard facts in the face. Since the days of "Hadi Process" the open pan system is surely making sugar during a period of over 20 years, but still the factory system has made enormous strides during the last three years.

The one point at issue is that the open pan system of making white sugar cannot compete with the factory system, and is bound to disappear in course of time just as it has already done in other countries. Similarly even the small inefficient sugar factories are bound to make room for large efficient ones.

The open pan system has certainly a place in the production of *gur* from pure cane juice and not from a mixture of juice and molasses or from molasses. Any improvements in that direction are certainly welcome in the interests of the small cultivator who produces *gur* for eating and not refining purposes.

During the period that the sugar tariff lasts, I think serious efforts should be made to put the sugar industry on a sound basis so as to be able to compete with foreign sugar in the Indian market even if the tariff is removed. Efforts to improve the open pan system are not likely to achieve much more than what has been done during the last 20 years, and may even give a set back to the sugar industry in the long run.

If facts and figures are brought forth to prove that the *Khandsari* can make more money by making sugar than by making *gur* of good quality, then I am prepared

to revise my views. As it is, when *gur* is selling at about ½ the price of sugar, people interested in the industry think it not at all worth while to make sugar but make only jaggery.

B. N. IYENGAR.

Dept. of Agriculture, Mysore,
Bangalore,
September 12, 1934.

The Multiplication of Scientific Societies.

AMONG the interesting items included under the head of Science Notes in the August number of *Current Science* is an announcement of the formation of a Biochemical Society in Calcutta. Immediately above this item is a notice of a joint meeting in Bombay of the Society of Biological Chemists, India, and the Grant Medical College Physiological Society. The need for another Biochemical Society is therefore hardly apparent.

The incident is only too characteristic of the fissiparous tendency apparently inherent among Indian organised bodies, scientific and other.

Some time ago there was a movement for the foundation of a "Society of Applied Chemistry" in Bombay, regardless of the fact that the "Institution of Chemists (India)" was doing much the same kind of work, not without difficulty, in Calcutta.

Apart from the expense and trouble of maintaining separate literature and collecting separate subscriptions, a much more serious result of this multiplication of scientific societies is the increased isolation of scientific workers. Even if an individual can afford the expense to subscribe for and the time to look through the various publications containing the papers in which he may be interested, it all adds unnecessarily to the difficulty of keeping intelligently in touch with scientific progress.

In the majority of cases it is likely that only a few papers are read concerned with the particular corner occupied by the subscriber to the specialist publication.

I have long felt and advocated that all *chemical* work done in India, whether "pure" or "applied", "specialist" or "general," should come under the cognizance of the Indian Chemical Society.

There would seem no reason why the different societies should not be affiliated to the Indian Chemical Society so that they may work together as a single organisation.

All papers read at these affiliated Societies might be offered either in full or in abstract for publication in the *Journal of the Indian Chemical Society*. It will doubtless be convenient for these "affiliated" papers to be published together in sections under the heads of "Biochemistry", "Applied Chemistry," etc., and such sections to be available, if necessary, at reduced prices to readers not full members of the Indian Chemical Society.

While geographical conditions may render necessary local bodies of more or less independent personnel, a central medium of publication through the good offices of the Indian Chemical Society would seem to be called for in order to maintain the breadth of outlook which is so greatly needed in present-day India.

Business details such as the proportion of subscriptions to be paid to the central and local societies should not be difficult to arrange, on the lines adopted by such bodies as the Institute of Chemistry and the Society of Chemical Industry, and others, in giving financial support to their local sections.

GILBERT J. FOWLER.

Central Hotel,
Bangalore,
September 8, 1934.

Note on Excavations in a Prehistoric Site at Kilpauk, Madras.

By M. D. Raghavan and T. G. Aravamuthan.

THE existence of a prehistoric cemetery in Kilpauk, Madras, has been known for about twelve years past, but only to a few persons interested in prehistoric archæology.[1] The site is included in the garden of the bungalow 'Fontenoy', which belongs to Mr. E. R. Prudhomme and is situated on Hall's Road, Kilpauk. Mr. Prudhomme had collected the pottery he unearthed in laying out his garden, the finds including a small sarcophagus and small vessels of various types among which could easily be recognised the black-tipped ware, with rim and inside black and the rest red, which is a dominant feature of the pottery found at Adichanallur in the Tinnevelly District. Attention has been called to the great resemblance which South Indian prehistoric pottery bears to the pottery of pre-Dynastic Egypt.[2] No attempts having been made so far to explore the site, we deemed it desirable to excavate the site methodically and collect the antiquarian remains for the Madras Government Museum to which we are both attached.

With the kind permission and encouragement of Mr. Prudhomme we started in August 1934, excavating at a spot which appeared likely to yield favourable results. Excavations are still proceeding.

The first day's excavation was fruitless. The next day, however, what appeared to be the rim of an urn was revealed, and it turned out to be a big-sized cinerary urn, with its sides badly broken, though the contents helped to keep them in position. The arrangement of the smaller vessels, both inside and around, was of great interest. These were vessels of different shapes and among them were specimens of the black-tipped ware referred to above and some fine specimens of all-black pottery.

Further excavation yielded more specimens of all-black ware, a figurine of black pottery of high polish, apparently representing a bird, and a half of a fine specimen of a pottery bead. Two iron objects were also found, one a small hoe-blade of a very primitive type, with a slightly curved cutting edge and a narrow butt, and the other a stick of iron, about 6 inches long, found broken in two, all highly oxidised.

Subsequent excavations have unearthed a sarcophagus about six feet in length, standing on six pairs of short legs. It resembles the specimens found at Pallavaram and Perumbair. It has, however, been so badly damaged by the roots of a mango tree growing close by that all attempts to raise it whole have failed. It is accordingly being removed in sections. It was found filled with sand and fragments of pottery. A bit of a bone was found close to it which is identified as the head of a human tibia. The deposits are generally found at depths varying from 3 to 7 feet below the surface, buried in a bed of 'river sand'. The site is being mapped out and stratigraphical records are being kept.

While the present finds exhibit characters common to other prehistoric sites in the Presidency, they present distinctive features which mark them off from previous finds. While no sarcophagus was found at the Tinnevelly site, urn burials alone being in evidence,[3] both the types occur at the Kilpauk site as at Perumbair. The scarcity of iron objects among the associated finds, furnishes another parallel with Perumbair. There is, however, a marked difference in the nature of the pottery found. Unlike Perumbair, the Kilpauk site is rich in fine pottery and abounds in bowls of black-tipped ware which are comparatively rare at Perumbair. The fine all-black vessels of the Kilpauk site distinguish it from both the Adichanallur and the Perumbair finds. The black pottery figurine, perhaps a votive offering, is a significant find as such figurines have not been met with in similar sites, excepting the Nilgiri cairns.

A number of handicaps attend any attempt at establishing the chronology of the South Indian prehistoric cultures. The distinctive characteristics of this find, and its chronology in relation to the other finds

[1] It is probably this site that Mr. L. A. Cammiade refers to as a large prehistoric cemetery in the vicinity of Chetpet, Madras, in his paper in the *Indian Antiquary*, **LXI**, 21-3. Mr. Prudhomme tells us that Mr. Cammiade inspected the site about twelve years ago and saw the pottery that had been collected then and the sarcophagus we came across.

[2] By Henry Balfour, F.R.S., in *Man*, September 1932, No. 251.

[3] A. Rea, *Cat. of Prehistoric Antiquities: Adichanallur and Perumbair*, 47.

in South India cannot be determined till the excavations are completed and the excavators have had further time to study the finds in detail. All that can be said at present in regard to the age of the site—and that tentatively,—is that the pottery found appears typical of the Iron Age pottery found at other prehistoric sites in South India such as those at Adichanallur, Perumbair, and Raigir in Hyderabad, and that the character of the associated finds of pottery bead and iron objects point to the finds being assignable to the Iron Age in South India.

Prophylactic Antimeningococcus Vaccine.

By Lt.-Col. H. E. Shortt, I.M.S.,
Officiating Director, Central Research Institute, Kasauli.

THE recent comparatively high prevalence of cerebro-spinal meningitis all over India has necessitated the Public Health Authorities taking all means in their power to check the disease. The fact that the disease has appeared in mild epidemic form in nearly every part of India, and the modern facilities for rapid transport which now exist, have emphasised the need to regard the outbreaks seriously and to employ every method, general or special, to prevent the menace assuming greater proportions.

Apart from general measures of public health two lines of attack are available, *viz.*,

(*a*) to treat the disease efficiently in those attacked;

(*b*) to prevent the disease by the use of a suitable prophylactic vaccine.

The only effective method of treatment of the disease is by the use of Antimeningococcus serum but even this method has given very varying results in different countries. The cause for this is not certain but probably several factors are involved such as varying virulence of strains, varying methods of preparing the serum and inadequate technique in dosage and methods of administration, including the continuous bacteriological control required in the treatment of cases. These factors, combined with the cost of the serum, ruled out its extended use in India except in large towns with good hospital and laboratory facilities.

There remained the second method of control and the Public Health Commissioner with the Government of India decided on the preparation of a prophylactic vaccine which could be used to immunise those exposed to possible infection in districts where the disease was known to be prevalent.

Such a vaccine had already been extensively used in Turkey with results reported to be favourable.

In pursuance of this policy an officer of the Central Research Institute was deputed to collect Indian strains of *Meningococcus* from cases of the disease occurring during the recent epidemic. It was not possible in the time available to collect these from all over India but, besides those locally obtained in the Punjab and Delhi, cultures were sent to the Central Research Institute for comparison from the Haffkine Institute, Bombay, which had been collected in South India. A comparison of these with the Northern India strains showed them to belong to the same types of *Meningococcus* so that the Delhi strains were considered as probably suitable for the preparation of a vaccine which would be effective all over India. Later work in England with cultures of these strains sent from Kasauli has shown that they are also practically identical with the strains occurring in England. From the Delhi strains, therefore, a vaccine was prepared which was submitted to thorough tests on volunteers for local and general reactions and on experimental animal for toxicity. On the satisfactory completion of these tests the vaccine was prepared on a large scale and has now been available to the public for more than 3 months.

As the full value of such a vaccine could only be assessed after extended trial the Government of India decided that up to November 1931 it should be a free issue from the Central Research Institute, Kasauli, in order to popularise its use. Up to the time of writing 26,518 c.c. have been issued.

INDICATIONS FOR USE OF THE VACCINE.

It should be emphasised that the vaccine is purely a prophylactic one and is not intended to be used as a curative vaccine.

In a country like India its chief use would appear to be in institutions such as schools, colleges, jails, hospitals, etc., where cases of cerebro-spinal meningitis occur every year. In such institutions its use once a year would, it is hoped, greatly diminish the incidence of cases. In districts, also, where the disease is especially prevalent it might be desirable for all those likely to be exposed to infection to be vaccinated and the same would hold good for the staffs of hospitals which are likely to admit cases for treatment.

It should also be emphasised that the best time to introduce vaccination is not during the height of an epidemic but before its onset in order to prevent its occurrence or at least limit its extent.

Research Notes.

An Improved Wire Grating Spectrometer for the far Infra-red.

IN a recent issue of the *Review of Scientific Instruments* (1934, **5**, 237-243), Bowling Barnes describes an improved type of spectrometer for the far Infra-red using a wire grating. The radiation from a strip of a Welsbach mantle heated by a gas flame is rendered parallel by a system of three concave and two Newtonian mirrors and is made to fall on the specially constructed wire grating. The diffracted pencil is then focussed on a radiometer by another system of concave and Newtonian mirrors. In order to avoid either moving the radiometer or rotating the grating, a very ingenious method of selecting particular portions of the spectrum produced by the grating, originally due to Pfund (*J.O.S.A.*, 1932, **22**, 281), is described. This device is a plane mirror which reflects the diffracted pencil on to the system of focussing mirrors. Adjustment of the position of this mirror enables the selection of different angles of diffraction and thus different portions of the spectrum. If the angle between the position of the mirror for reflection of the central image on to the radiometer and any other position is $\theta/2$ the angle of diffraction in the latter case is θ. This angle is measured very accurately in the instrument.

The grating itself, which is of the transmission type, is made by winding uniform wire over two parallel screws mounted in a framework, soldering the windings of the wire to the screws and cutting them away from the back portion. Even orders are absent in such a grating and so the problem of eliminating overlapping spectra reduces itself to diminishing the intensity of the third order sufficiently. A method of doing this is also described. The instrument can be used for infra-red work both by reflection and by transmission by substances, the specimen being substituted for one of the Newtonian mirrors in the collimating system in the one case and placed in between two of these mirrors in the other case. In this instrument, using a 0·4166 mm. grating, lines, the components of which are known to be $1{\cdot}33\nu$ apart, can be resolved and the wave-lengths of sharp lines can be measured to $\pm 0{\cdot}12$ cm.$^{-1}$

S. R. S.

The Shape of Long Chain Molecules.

THE present ideas of the shape of straight chain molecules in solution are contradictory, and the question is interesting from the point of view of recent measurements of viscosity and streaming double refraction in sols with needle-shaped, spherical, rigid or flexible particles. The long chain molecules on account of the number of links and the more or less free rotation possible about each of them, can assume, besides their stretched form, numerous other shapes which have all nearly the same energy. The shape to be expected on the average is an interesting statistical problem, and Werner Kuhn has treated it as such in *Koll. Zeit.*, July 1934, **68**, 2. A chain of Z links is divided into n segments containing s links each, such that the average direction of each segment is independent of the preceding one. Such a perfectly irregular arrangement will lead to the shape of a complicated coil, and it is shown that if the individual volumes of the links are neglected, the resulting shape of the irregular coil will be that of a bean, whose rates of length to breadth to thickness is 6 : 2.3 : 1, and the volume will be $\frac{\sqrt{\pi}}{12} b^3 Z^{3/2}$, where b is a measure of the average length of each segment. The value of b is given by $3b^2 = s l^2 \frac{1+\cos\beta}{1-\cos\beta}$ where l is the length of each link, and β the supplement

of the valency angle. When the velocity of ring formation considered as proportional to the probability of finding the two reacting ends of a chain near each other, is compared with actual observation, the necessity for allowing for the volume of the links is very much evidenced. When due corrections for this volume effect are adopted, the viscosity and other measurements support the bean shape of the chain molecules as against a stretched form. M. A. G.

A New Type of Phase Advancer.

In a recent paper (*Proc. Ind. Acad. Sci.*, 1934, **1 A**, 98) J. J. Rudra describes a new type of phase advancer which acts as a combination of expedor and susceptor phase advancers and is suitable for use with large induction motors used as asynchronous condensers. The motor of the phase advancer has a slip ring winding and a commutator winding as in the Schrage motor. The former is supplied with voltage of line frequency through the secondary of an induction regulator. The stator has field and compensating windings as in the Miles Walker phase advancer which are connected through suitable brushes in series with the commutator winding and the slip rings of the asynchronous condenser. The theory of an induction motor connected to this and other phase advancers, and current loci of a 1500 h.p. motor connected to various phase advancers are given.

Contributions to Our Knowledge of the Cranial Anatomy of South Indian Ranid Genera of Frogs. Part I.

In an article (*Proc. Indian Acad. Sci.*, 1934, **1**, No. 2, B) certain aspects of the cranial morphology of the South Indian Ranid genera of frogs are described by Mr. L. S. Ramaswami. The author is trying to examine the statement of herpetologists that the genera *Rhacophorus* and *Philautus* could be merged together and also to place the classification of the several species of *Philautus* on a sounder basis by introducing certain cranial characteristics. Among the forms studied *Ph. petersi*,—a native of Siam—seems to be specialised in certain features. The possession of a well ossified cranium, a complete os en ceinture and the co-ossification of the frontoparietals, exoccipitals and prootics in the auditory region where no delimitations are observable, seem to be specific to the foreign species of *Philautus* examined. The presence of the bursa oris angularis in all the forms described is an interesting feature. The bursa had been compared with the tonsils of man by Prof. Fuchs and investigators are not unanimous in accepting Fuchs' view though the gland is definitely shown to be adenoid in nature. The tongue possesses a median papilla in the two South Indian specimens examined, which upsets Boulenger's division of the species of *Philautus* into two groups by lingual characters. Describing the larval habits of Indian *Philautus* the author states that the froth-making habits so common among the foreign forms are not observed in the Indian *Philautus* thereby differing from the observations of Prof. Noble. In conclusion the author points out that the investigated species of *Philautus* cannot be merged with *Rhacophorus*.

Chromosome Studies in Allium; The Meiotic Chromosomes.

T. K. Koshy (*Journ. Roy. Micros. Soc.*, **54**, Part 2, June 1934) describes two coiled chromonemata in all stages of meiosis in Allium. This condition observed in the last premeiotic mitosis occurs as intertwined threads in the early leptonema of the meiotic phase. The pairing of the chromosomes simultaneously at both ends of the chromosomes is observed till a side by side association is established. A strepsinema is observed during the diplotene stage. Quadruple structures are formed by the close association of the homologous dual chromosomes, the cleavage being completely suppressed in the first meiotic division. Cleavage of the cromonema occurs in the late prophase of the second division, the univalent chromosomes moving apart to the poles of the heterotypic spindle having in them a two-coiled chromonemata. Meiotic chromosomes are similar to somatic chromosomes in their structure and behaviour. Synapsis at heterotypic prophase and suppression of cleavage at the first division effect the genetic requirement of the reduction of chromosomes.

The Geology of the Sakarsanahalli Area.

An important paper on the origin and correlation of the metamorphic rocks of the Sakarsanahalli area, Kolar District, by Messrs M. B. Ramachandra Rao (of the Mysore Geological Department) and K. Sripada Rao

(of the Mysore University) has been recently published (Bulletin No. 14 of the Mysore Geological Department, 1934) in which the authors have given a detailed account of the rocks of the area, with special reference to their origin and correlation. The rocks of the area arranged in the order of their relative ages are :—

The Schists.

I. Hornblende schist.
   (*a*) Tarurite.
   (*b*) Limestone.
II. Amphibolites.
   (*a*) Hornblendites.
   (*b*) Tremolite-Actinolite schists.
   (*c*) Cummingtonite schists.

The Gneisses.

   (*a*) Champion gneiss.
   (*b*) Peninsular gneiss.
   (*c*) Quartz reefs and Quartzite.

Dolerite.

The area is largely composed of gneisses with numerous caught-up patches and thin lenticular bands of hornblende schist and amphibolites. The former in many places are intruded by quartz and aplitic veins resulting in a series of metamorphic rocks called "Tarurites". By far the most prevalent and conspicuous change produced is the conversion of the amphiboles into pyroxenes with the development of contact metamorphic minerals like calcite, garnet, rhodonite, scapolite, epidote, zoisite and apatite. Intense calcification and alteration of these Tarurites has yielded manganiferous limestones in places.

The amphibolites are of the nature of hornblendites or tremolite-actinolite schists or cummingtonite schists. The contact metamorphism of the tremolite-actinolite schists in places has given rise to rocks containing sillimanite and cordierite. The cummingtonite schists through metasomatic alterations appear to have yielded ferruginous quartzites in places.

The numerous patches and shreds of hornblende schist, amphibolite, and tarurite must have at one time formed a more or less continuous series but are now much torn up, isolated, and severely disturbed by the later intrusive gneissic granites. There is, however, no doubt regarding their original igneous origin. With regard to the tarurite, limestone, and sillimanite-cordierite rocks of this area, an original sedimentary origin was suggested some time back and an attempt made to correlate them with the Gondite or Kodurite series of Dr. Fermor; but the present studies do not support such an idea. On the other hand, there are ample evidences to show that they are only alterations of the hornblendic rocks by contact metamorphism brought about by acidic intrusions and subsequent metasomatic or meteoric changes.

The paper is fully illustrated with maps, sections, and photographs.

The Morphology and the Systematic Position of a New Trematode from the Intestine of the Golden Orfe, *Leuciscus idus*, with a Note on the Classification of the Family, *Allocreadiidæ*.

In the *Journal of Helminthology* (**XII**, pp. 127-136), Dr. G. S. Thapar and Mr. J. Dayal have described a new Trematode from the golden orfe. The genus is named *Cotylogonoporum* and is characterised by the presence of the genital sucker, the intertesticular position of the lobed ovary, the disposition of the uterine coils and the peculiarities of the oötype complex. The genus under review resembles the genus *Sphærostomum*, a form which was placed by Poche(1925) under the family *Allocreadiidæ* and is therefore placed near it. The authors in the present communication have rightly separated the latter from this family and have further justified the creation of a new family *Sphærostomidæ* for the reception of the two genera *Sphærostomum* and *Cotylogonoporum*. A general discussion on the family *Allocreadiidæ* follows the account of the genus *Cotylogonoporum*. The authors have clearly shown that the presence of the genital sucker in the present case indicates the affinities of the present genus with the members of the family *Heterophyidæ* and further researches may show it to be a transitional form between the two older families of *Allocreadiidæ* and *Heterophyidæ*.

Recent Developments in Anthropology, Ethnology and Ethnography in India.

By Dr. P. Mitra,

Department of Anthropology, Calcutta University.

INDIAN Anthropologists are in deep debt of gratitude to the grand old man of the science in India, Prof. L. K. A. Aiyar, for keeping on record the 'Recent Developments in Anthropology, Ethnology and Ethnography in India' and its publication in *Current Science*, January 1934. When it received the kind notice of the official Anthropologist of the Government of India, it was expected that all lacunæ would be filled up in his communication (published in *Current Science*, May 1934) but as the expectation has not been realised, it was considered desirable to record the following for the sake of completeness of the survey.

Physical Anthropology.—Dr. A. C. G. da Silva Correia, author of at least twenty-seven papers since 1900 on the demography, morphology, anthropometry, ethnography and acclimatisation of the Indo-Portuguese Lusos, has been responsible for a considerable amount of brilliant work in recent years, and thanks to his colleagues, the school of Medicine in New Goa has been fast coming into prominence as the centre of researches in Physical Anthropology. Dr. Fracncisco Correa in his "Recueil de quelques faits anatomiques et teratologiques concernant les habitants de l'Inde Portugaise," records the muscular, vascular and nervous anomalies of several Goanese;[1] Dr. Pegado in his "Anthropological Researches of not bony parts, on the living of 175 natives of Portuguese India" (1931)[2] offers valuable information on certain muscles and forearm veins; and Dr. C. Mascarenhas in his "Contribuiçao para o estudo antropológico de Goa"[3] discusses the measurements of twenty Goanese crania. It is refreshing to find that the medical school at New Goa has not confined its physical anthropological studies to the discussions of whether or not we were originally negroid or australoid or mongoloid.

It is surprising to find that the important work on blood-groups in India has not been mentioned in the previous surveys of both Prof. L.K.A.Aiyar and Dr. B. S. Guha. Pandit's[4] researches have considerably added to our knowledge on 'Blood-groups distribution amongst the Todas'. Chaudhuri has been carrying on valuable researches on blood-groups amongst Bengali Kayasthas parts of his results being published as 'Blood-groups and Heredity'.[5] The publication entitled "The distribution of blood-groups in certain races and castes of India" by Malone and Lahiri,[6] deals with the data for Pathans, Baluches, Rajputs, Jats, Khatris and Dravidians. Krishnan and Vareed have studied the "Basal Metabolism of young College Students, men and women of Madras" with Benedict Roth system with rubber flutter valves and Collin's Kymograph attachment.[7] Mukherjee[8] has published a preliminary note on the Basal Metabolism of Bengalees using Douglas bag and Haldane gas analysis apparatus.

Ethnology.—The well-known ethnological researches of Datta specially his "Eine Untersuchung der Rassenelemente in Belutschistan, Afghanistan und den Nachbarländern des Hindu-Kusch" and the "Das Indische Kastensystem"[9] deserve special mention as also the works of the workers of the sociological school in Bombay under the direction of Ghurye. Special mention may be made of the well-known work on Hindu Exogamy by Karandiker. In the Assam valley J. K. Bose and others have carried out important researches on the Aimols, Kabui Nagas and Marings and on Dual Organisation and Sorabjit Singh on Meithei Ethnography and juridical ethnology. The name of P. C. Biswas who recently proceeded to Berlin as Humboldt Fellow, may also be mentioned in this connection, he has contributed to the International Anthropological Congress, papers dealing with "the Primitive concepts of disease in India" and on Santal Ethnography. J. K. Gan has carried out valuable comparative cultural studies in India and Africa[10] and is now engaged on craniometric and anthropometric studies under Chatterji, who, it may be mentioned, has recently discovered important correlations between the vital capacity, height and weight amongst the data for thousands of Bengalees.

Amongst those that have largely contributed to the growth of Indian Anthropology, mention must be made of Crooke. His book entitled "Tribes and Castes of North-Western Provinces and Oudh" was published in 1896, in four volumes. Thurston's "Tribes and Castes of Southern India" (1909), Russell and Hira Lall's "Tribes and Castes of Central Provinces" (1916), Enthoven's "Tribes and Castes of Bombay" (1920-22), Waddel's "Tribes of the Brahmaputra Valley,"[11] Gurdon's "Khasis" (1914), Playfair's "Garos" (1909), Hodson's "Naga Tribes of Manipur" (1911), Shakespeare's "Lushei-Kuki Clans" (1912), Rivers' "Todas" (1906), Shaw's "Thadou Kukis"[12] and Parry's "Lakhers" have always been considered as classical works in the subject. The monumental work of the great European palethnologist Prof. V. Giuffrida-Ruggeri who did pioneer work in "the Systematic Anthropology of Asia" was largely responsible for establishing the conclusions of Rai Bahadur R. P. Chanda's theory of Alpine

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[1-3] *Arq. Esc. Med. Cir. Nova Goa*, Ser. A., No. 7, pp. 1293—1365.

[4] *Ind. J. Med. Res.*, **21**, No. 3, January.

[5] *Ind. Med. Gaz.*, April, 1931, **66**, No. 4, pp. 193—195.

[6] Malone and Lahiri, *Ind. J. Med. Res.*, **16**, pp. 963—968.

[7] *Ind. J. Med. Res.*, 1932, **19**, pp. 831—858.

[8] *Calcutta Med. J.*, **20**, 425; also Mukherji and Gupta, *Ind. J. Med. Res.*, 1931, **18**.

[9] *Anthropos*, 1927, Band **22**, pp. 142—159.

[10] *Man in India*, **13**, No. 1, pp. 17—54.

[11] *J. Asiatic Soc. Bengal*, 1901, **69**, Pt. 3.

[12] *Jour. and Proc. Asia. Soc. Bengal*, N. S. 1928, **24**, No. 1, pp. 1—175.

element in Indian population—a conclusion which we learn is going to be produced anew by the irksome labour in anthropometry in the last census. Sir William Turner and Sir W. H. Flower did pioneer work in Indian Craniometry and Osteology. For the sake of completeness mention may be made of the following :—Sullivan, for his work on "Andamanese Skulls",[13] Duckworth "Note on the Skull of an Andaman Islander", Zuckermann and Elliot Smith, "Researches on the Aditannallur Skulls",[14] Charles, "On Punjab Craniology",[15] and Tildesley, "Burmese Craniology".[16]

[13] *Anthropological Papers of Amer. Museum of Nat. History*, 1921, **23**, Part IV, pp. 175—201.

[14] *Bull. of the Madras Govt. Museum*, 1930.

[15] *J. Anat. and Phys.*, 1907, **27**.

[16] *Biometrika*, 1921, **13**, pp. 176—262.

The Agricultural Basis of Religion in India.*

THE religious beliefs and practices in India have received greater attention than any other branch of Indian Culture. The studies attempted so far have preceded either on a comparative or a philosophical basis. But in the study of the primitive and other forms of religion in India, it would appear that fruitful results may be obtained by approaching it from a different angle : namely, by a study of the influences of environment. It seems to me that an examination of the predisposing influences is bound to throw light on the religious practices and beliefs and enable us to interpret properly the anthropological data with accuracy.

I have taken for the theme of my paper "The Agricultural Basis of Religion". Lest the title mislead the reader, I should explain that the circumstances under which agriculture is being carried on in India have exerted an influence on the religious practices of the agricultural castes. The fact that they are widespread and are followed by a large proportion of the people will be evident from the fact that India is essentially an agricultural country and this occupation affords employment to more than three-quarters of the population. As satisfaction of material wants is the chief aim of man, primitive or civilised, the influences which contribute to the success in his efforts also react on his mental outlook. Agricultural operations, whether in Northern or Southern India, are largely determined by the monsoon. The outbreak of the monsoon at the proper time ensures a successful agricultural season, overflowing granaries and provision of sufficient means to the people ; whereas a failure of the monsoon spells economic disaster. As the monsoon is the outcome of the uncertain forces of nature, the agricultural castes find themselves absolutely at the mercy of these influences. It is, therefore, not unnatural that this should produce a spirit of fatalism. Again the fact that land is the chief thing that determines the material welfare of the people is the main reason why so much of ritual, magic and religion is associated with "Mother Earth". The extent to which these two have influenced the religious beliefs, practices and attitude of a large propotion of the agricultural castes in India will be clear from a consideration of the agricultural calendar and ceremonies connected with this occupation.

The agricultural year in South India, especially in Malabar, Cochin and Travancore, begins with *Vishu* or Chaitra Sankranti, which is the astronomical New Year's Day on which the hot weather is supposed to terminate. The sight of the food-stuffs and silver or gold arranged in a bell-metal tray on the morning of the auspicious day is calculated to bring on prosperity during the ensuing year. It is also a day for ancestor worship and worship of the deities in the village temples for the blessings of prosperity. The village astrologer by his calculations announces the agricultural prospects of the year and forecasts the amount of rainfall at regular intervals, the names of the crops that are likely to thrive well, and the famines or epidemics that are likely to break out. Each member of the village consults the astrologer who by the examination of his horoscope predicts his good luck or otherwise during the ensuing year. The same prosperity or ill-luck is determined by the omens arising from the breaking of cocoanuts, and the direction of its rolling on the floor on the morning of the first day of the agricultural year.

The village astrologer next chooses a special day for ploughing and sowing. The seeds are taken in leafy cups, and placed in a basket, and are consecrated. The plough and other agricultural instruments and the oxen are worshipped. They are next taken out in procession to the field. The headman leads by starting to plough and the others follow. Sowing is regarded as a general crisis, a "Rite de passage", and the chief assumes the risk of performing an act full of mystical danger and of uncertain outcome. It is thus a solemn act and is done with prayers to ancestors who are invoked for the prosperity of the crop. When the crops are grown up, the Siddi-Devaru is worshipped with offerings to avert insect pests. The fields and crops are placed under the protection of the village deity, after the offerings to the deities and after Hasta Pongalu during the Hasta rains.

When the crops are fully ripe, there is a special ceremony for bringing them to the family. The house is white-washed and decorated with drawings of rice flour mixed in water. The ground in front of the house is purified with cow-dung mixed with water, and decorated with seven kinds of leaves. The God Ganesa is propitiated and adored. The ears of corn are stuck to the wall with cow-dung. This is followed by a formal cooking of rice obtained from the newly cropped

*Summary of a paper by Rao Bahadur L. K. Ananthakrishna Iyer, read before the First International Congress of Anthropological and Ethnological Sciences, London, 1934.

paddy, which is a survival of the Vedic ceremony of Agrâyana.

The ceremony next in importance is the worship of the agricultural implements on the Vijayadasami day, during the Dasara of South India. This corresponds to the Viswakarma day in Bengal. There are also special forms of worship before harvest. At the time of reaping the sickle God is worshipped. A handful of the crop is then cut and placed in the central part of the field, and near it five stones are placed. The sickles of all the reapers are collected and deposited in a row in front of these stones. They are all worshipped with the breaking of cocoanuts and the burning of incense. The ears of the corn are safely preserved at home and the grain obtained from them is mixed with the seed grain during the ensuing year. Before the grain is removed in carts or head-loads from the fields to the threshing floor, a cocoanut is broken and incense burned. When the threshing is done and the grain heaped together a similar offering is made to the *pillari*. It is also the universal custom that, before measuring, a small portion of grain is set apart for distribution to the poor villagers who may chance to go there.

There is also a similar ceremony at the end of Magh or Makaram, when the crops have been harvested, the agricultural operations have come to an end, and Mother Earth is supposed to take some rest or remain in a state of incubation. At the beginning of this period, the agricultural castes of Malabar observe a festival in honour of Mother Earth which is like the Roman Februria supposed to take place at the same time. It is believed that on the last day of the festival all agricultural leases connected with the land are supposed to expire. In some of the villages of the Walluvanad Taluk of Malabar, special festivals are celebrated with straw models taken out in procession to the Bhagawati Temples.

After the harvest the farmers and others in the villages find their granaries full. It is during this part of the year that all the village festivals are celebrated in honour of the Gods as thanks offerings with prayers for similar harvests in the following year.

Research in Irrigation.

THE Fourth Annual Meeting of the Research Committee of the Central Board of Irrigation was held in Simla on the 19th and 20th July, 1934. Officers from the following Provinces were present:—Bombay, Sind, United Provinces, Punjab, Bengal, Madras and North-West Frontier. The Meeting of these Officers is of considerable value as it leads to the co-ordination of research work, the exchange of views with a consequent development of new lines of research, and affords an opportunity for the discussion of the particular problems with which each Officer has to deal.

The Agenda for the Meeting included: (i) a discussion of the research work carried out during the year in each Province, (ii) reports on the progress made on a number of investigations, and (iii) the consideration of investigations started during the previous year. As irrigation is of such great importance to the whole of India, a brief summary of the Proceedings may be of interest.

The reports on the work done showed the importance now attached to model experiments. In Bombay, models were used to determine methods for the exclusion of silt from canals and to determine the coefficient of discharge of the Sukkur Barrage Gates. The models studied in Sind had reference to the number and position of the vanes to give a suitable distribution of velocities over the normal section of the channel below flumed falls and regulators, to the coefficient of discharge of radial gates and to the determination of the modifications necessary to eliminate heavy action downstream of a syphon. The report of the Irrigation Research Institute, Lahore, showed that two types of experiments on models were being carried out. The first type dealt with the protection of the downstream glacis of weirs. A system of protection depending upon the throwing of the high velocity water to the surface has been evolved. This form of protection reduces scour to a minimum, and hence will reduce considerably the cost of maintenance of headworks. The second type of work on models deals with the flow of water under works and the pressures involved. Some reference has already been made to this subject in this Journal (Vol. II, April 1934, No. 10). The recent developments are connected with the determination of the effect of an upstream sheet pile on the pressures on the work. The Central Board of Irrigation has now agreed that no major work should be constructed without first being studied in model form.

An important discussion took place on the seepage losses from canals, distributaries and water-courses. Observations made in the United Provinces showed that the major losses occurred in the water-courses and distributaries. The complementary subject of linings was also discussed. The conclusion reached was that lining was not a feasible method of dealing with the losses on large channels which had already been constructed, but that the lining of distributaries and minors was a practical proposition. As the greatest losses occur on these latter types of channels it was agreed that any scheme for lining would be best commenced from the minors.

Considerable attention has been devoted by the Research Officer, Sind, to the study of waterlogging and drainage. The Research Division has a most elaborate system for studying the variation of the level of the sub-soil water-table. The results reveal a rise of water-table in certain areas and indicate that measures will have to be taken at no distant date to control the rise. Before any irrigation scheme is contemplated in future, the example of Sind in this respect should be followed.

In the Punjab the effect of rainfall and irrigation on the water-table has been studied in the areas commanded by the Upper Chenab Canal and Upper Jhelum Canal. It has been shown that there is a high correlation between the movement of the water-table in these areas and the amount of monsoon rainfall. As a result the Government

has decided to develop the drainage in the northern areas of the Punjab during a period of five years.

In the Punjab the progress on the study of alkaline soils is reported. These investigations have been conducted in connection with three allied problems:—(1) The prevention of land deterioration under irrigation. (2) The study of land reclamation. (3) The quality of irrigation of water.

A factor known as "Degree of Alkalisation" of the soil has been a subject of study during the year. It has been shown that crop yield in the plains of the Punjab decreases as the "Degree of Alkalisation" increases. It has further been shown that a relatively small proportion of calcium in solution can prevent alkalisation of the soil associated with the presence of the sodium salt. The equilibrium conditions for a system "sodium salt —calcium salt—calcium sodium clay" have been studied and the results are now being applied experimentally in the field. These results also have an important application in determining the quality of irrigation water that can be safely used without soil deterioration taking place. It has been shown that water containing above 60 parts per 100,000 of sodium salts in solution results in base exchange and hence the soil deterioration. The presence of a small amount of calcium salt in such a water can prevent this reaction. The quality of irrigation water is a subject of special importance in the Punjab at the present time as proposals have been made for a development of irrigation by means of tube-wells following on the electrification of the Province.

Considerable discussion took place on the silt and flow theories which have been put forward by Mr. Lacey. While some of his formulæ were accepted others that had been tested both in the Punjab and in Sind showed that they did not, in their present form, apply to the channels in these Provinces. It was agreed that the formulæ were useful in connection with the remodelling of channels. Extensive studies have been made in the Punjab and in Sind to determine the relation that exists between the bed silt in the channel and hydraulic data of the channel. Two types of siltometers have been developed at the Irrigation Research Institute at Lahore and they are proving of great value in studying the characteristics of silt. The work done at Lahore has shown that the Distribution Curves for the bed silt in a silted, a scouring, and a stable channel have typical forms. A number which can describe a silt and which is a function of the weighted mean diameter of the silt particles is now being studied in connection with the hydraulic data of channels with the object of determining whether any relation between the silt and the hydraulic data exists. Results of these investigations will probably have an important influence on the design of channels and on cost of maintenance of channels already in existence.

At the conclusion of the discussion of the Agenda the Research Officer of Madras drew attention to the growth of weeds in channels in his Province, a subject which also appeared to be of considerable importance in Bengal. A solution of the problem would be of considerable economic value and the subject deserves intensive study.

The Chemistry of Milk.

ONE of the important discussions organised by the Chemistry (B) and Agriculture (M) Sections of the British Association for the Advancement of Science at their last session was on "The Chemistry of Milk".

Dr. Tocher contributed a paper on the *Composition of Milk and the Present Regulations*. The proportions of the constituents of milk are known to vary widely from sample to sample even in the case of bulked milk. In the case of fat and solids not-fat percentages, it is known that many cases occurred where the values fell below the prescribed presumptive limits under the regulations. Several instances are known where *genuine* milk has been held to be watered. Various workers have found that the freezing point of milk is the least variable of all physical characters, the coefficient of variation being approximately 1·5 as against 4·5 for refractive index and 5·0 for specific gravity. On account of its low variability the freezing point of milk has been frequently used as a criterion for "watering".

In the course of his paper on the *Chemical Composition of Abnormal Milk*, Dr. Dabies said: "Abnormality in buffer value in the acid range, in the balance of acidic and basic constituents, in the distribution of ionic acid and non-ionic metallic radicles (Ca), in the amounts of the various forms of casein present and in the amount of heat-coagulable protein, is reflected by abnormality in rennet action, 'curd tension' and in heat stability at temperatures above 100°C.

Dr. Linderstrom-Lang contributed an interesting paper on *Some Chemical and Physical Properties of Casein*. "Casein (caseinogen), the phosphor protein in milk, is a mixture of two or more substances. By treatment with acid alcohol it may be divided into several fractions that duffer in chemical composition, especially in their content of phosphorus. Mixing the fractions in their original proportions gives the original casein with its characteristic physical and chemical properties.

Investigations of the solubility of casein in acids and bases show its complex nature. The solubility is, under constant conditions, a function of the amount of casein present as precipitate, and the dissolved substances differ in chemical compositions from the precipitate.

The fact that casein is a mixture makes investigations of its chemical structure difficult. Due to its high content of phosphorus and the importance of this to nutrition problems, the mode of combination of this element has been the subject for elaborate studies. Experiments show that the phosphorus in casein is present as phosphoric acid and—at least partly—bound to serine by an ester linkage. As the phosphorus content of the different fractions of casein is different, this problem is of importance to the explanation of the above-named physical properities.

Other papers that came up for discussion were *The Composition of Milk Fat* by Prof. T. P. Hilditch and *The Vitamins of Milk* by Dr. S. K. Kon.

Science Notes.

The Central College Mathematical Society.—This Society whose primary object is "to stimulate and encourage the study of, and research in, the field of contemporary mathematics", was recently inaugurated at Bangalore. The programme of the Society includes monthly meetings for the reading of original papers and weekly discussions on selected topics, the discussion being initiated by a member who has made an intensive study of the subject. It is also proposed to hold special discussions from time to time on problems of mathematical interest. The organisers welcome co-operation from all those interested in mathematics.

The inaugural address of the Central College Mathematical Society was delivered by Prof. K. S. K. Iyengar on the 3rd September 1934, Prof. B. Venkatesachar presiding. "Mathematical Philosophy" formed the subject of the address.

In the course of the address Prof. K. S. K. Iyengar pointed out that all arguments based on our experience show that they depend upon two important elements for their validity, sense data and certain general principles forming a group of intuitive truths, that is, they belong to the *a priori* aspect of our knowledge and cannot be proved or disproved although we come to realise their truth by experience. The elements of the *a priori* knowledge are called universals which in ordinary language mean qualities and relations. Whether universals and a knowledge of their relations being not empirical, are purely mental is a very important question. To assert that they are purely mental would lead one to great difficulties (Kantean doctrine) in the theory of knowledge. This difficulty is solved in Indian Philosophy by the assumption of an unchanging Universal Mind (*Mahat*) of which our minds are in some way parts.

The Professor then passed on to a detailed examination of the elements and methods of procedure in mathematics, stressing on the importance on the serial order. The fruitfulness of a critical examination of postulate systems with special reference to geometry, was pointed out.

"I may say that the essence of mathematical procedure is the postulation method and hence rigour is of the utmost importance in mathematics. Whenever anyone asks us whether mathematics deals with truth, we can only reply to him that we are all concerned here in drawing implications of a set of assumptions and there our business ends. No doubt we construct, out of our Universals, all possible worlds, but we do not know whether such worlds exist in the ordinary sense of the word in which I may say that we exist. True research of a high order in mathematics is in building up of such synthetic structures of relational Universals. Some of these structures may be of use some time later, in building up the theories of experimental sciences as, for example, the theory of groups and matrices has proved to be, in modern quantum mechanics." He concluded with a very appropriate quotation from Lord Russell that pure mathematics (or logic which is the same thing) aims at being true in the true Leibnitzian phraseology in all possible worlds and not merely in this higgedly-piggedly job lot of a world in which Chance has imprisoned us.

* * *

Twenty-ninth Half-Yearly Meeting of the Indian Central Cotton Committee.—The meeting was held on the 28th and 29th August with Diwan Bahadur Sir T. Vijayaraghavacharya, Vice-Chairman of the Imperial Council of Agricultural Research, in the Chair. Among the important subjects that came up for discussion, were (1) the immediate need for legislative measures to rid the cotton industry of the prevailing malpractices of watering and mixing of cotton which were widely condemned by leading cotton merchants and firms in Bombay; (2) the cultivation of improved varieties of cotton in the Barrage areas of Sind; (3) the campaign for extension, seed distribution and marketing of pure Sind-American Cotton; (4) and the future policy to be adopted in the case of the Institute of Plant Industry.

* * *

Asiatic Society of Bengal.—An ordinary meeting was held on Monday, 3rd September. Several valuable exhibits were shown and commented upon. Among them may be mentioned:—(1) Exhibition of four specimens of Deccan trap Basalts and Dolerites from the Chhindwara District, Central Provinces, by Dr. L. L. Fermor, (2) The Bahjoi Meteoric Iron, by Dr. M. S. Krishnan, (3) The Khanpore Meteorite by Dr. M. S. Krishnan, (4) Photographs of sun-shades for fishes, by Dr. S. L. Hora, (5) Three small Bronzes from West Africa, by Dr. S. K. Chatterjee, and (6) Three China Plates representing the three famous Buddhist Pilgrims, by Mr. Johan van Manen.

A course of four lectures by eminent scientists of the country were arranged under the auspices of the Society, at Calcutta during August and September. They were designed to convey instructive and interesting information in attractive form to a general cultured audience not necessarily composed of specialists.

(1) Trade in Live Fish (*Jiol Machh*) in Calcutta, by Dr. S. L. Hora (31-8-1934):—A great volume of trade in live fish has been built up in Calcutta which annually receives over 50,000 maunds of this article of food from the outlying deltaic stations. Fish is generally popular among the major sections of population in Bengal and if live fish can be obtained, there must naturally be a great demand for them on account of their greater flavour and nutritive qualities.

The consignment produced in the market represents a group of animals belonging to different families and their transportation to Calcutta from various mofussil centres is rendered possible by their capacity to breathe atmospheric air as well as water. They can be easily carried in large numbers in suitable cases in a live state. Dr. Hora dwelt at length on old methods of distributing the fish and described the present-day means. He drew attention to the several ways in which the imported fish and the local produce are distributed and in passing, touched on the culinary processes of preparing these articles for the table. Reference was made to the trade statistics together with remarks on the social and economic

conditions of the people engaged in this traffic. The periodic fluctuations in the trade which must necessarily affect both the consumer and the producer are accounted for by investigations into the general and seasonal habits of the fish.

Dr. Hora has offered practical suggestions for improving the quality of the fish offered for sale, which must be beneficial both to the consumer and the tradesman. Generally the live fish produced for sale in the Calcutta markets, go involuntarily on hunger strike tending to great slimming thereby impoverishing their nutritional value. One of the suggestions made by Dr. Hora for the preservation of fish in their proper condition till the time of disposal, is to investigate the natural food of the fishes and prepare nearly the same food or a good substitute on which they could be fed during the period of captivity.

(2) The North Bihar Earthquake of the 15th January 1934, by Mr. J. B. Auden (7-9-1934):—The lecture summarises the results of an investigation in the field of Mr. Wadia, Dr. Dunn, Mr. Ghosh, and the lecturer. The description of the severe damage caused by the earthquake regards two main zones: firstly, the central zone represented by the epicentral tract and the slump belt; secondly, the bordering Patna-Monghyr belt and the Valley of Nepal. A brief discussion of the more general effects of the earthquake, such as emission of sand and water, landslides, etc., is followed by an account of the possible causes, comparison being made with other recent Indian earthquakes. Finally, the lecture ends by discussing the time of the earthquake as deduced by seismographic records, and the question of future immunity in Bihar.

(3) The Fundamental Constituents of Matter by Dr. Meghnad Saha (15-9-1934):—The lecture will describe discoveries of the Electrons and the recent discoveries of the Positrons and the Neutrons. It will also deal with the probable existence of other probable fundamental particles as Dirac's Free Magnetic Poles and the probable effect of their existence on our views regarding the electro-magnetic origin of mass. The lecture will also deal with the nature of cosmic rays, the probable existence of a world of anti-atoms, and also certain other cosmological problems of fundamental importance.

(4) The Shan Hinterland: the country and its people, by Dr. M. R. Sahni (21-9-1934):—The speaker will give a talk on the prolific and amazing variety of tribes inhabiting the Shan States of Burma and deal briefly with their geographical distribution, their more interesting customs and traditions.

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Mr. D. Narayanamurti, M.Sc., A.I.C., A.I.I.Sc., A.Inst.P., of the Forest Research Institute, Dehra Dun, has been awarded a scholarship by the Deutsche Akademie. Mr. Narayanamurti will be sailing for Germany from Bombay on the 8th October. During his stay he proposes to devote most of his time to research on the seasoning of timber and to the study of X-ray technique as applied to the study of the properties of fibrous materials.

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Mr. V. Ramanjalu Naidu, Temporary Demonstrator in Physiology of the Medical College, Mysore, and a Medical Graduate of the Mysore University, has been awarded the Fellowship in Pathology by the Mayo Foundation, Rochester, U. S. A. He sailed for America *via* England on the 18th August 1934.

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We understand that Mr. G. B. Patel, a cotton breeder of Gujerat, has been granted a scholarship by the Central Cotton Committee for training in cotton breeding in U. S. A., for 2 years.

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Dr. D. R. Sethi has been confirmed as Director of Agriculture, Bihar and Orissa, in succession to Mr. G. S. Henderson.

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Dr. MacLagan Gorrie, D.Sc., I.F.S., of the Forest Research Institute, Dehra Dun, has been awarded the Leverhulme Fellowship, 1934, for carrying out researches on "The Correlation of Erosion Damage and Grazing in Forests".

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The Academic Council of the Muslim University has conferred its first Ph.D. Degree on Mr. Omar Farooq for a thesis entitled "The Directive Effect of Substituents on the Thiazole Cyclisation of S-Diarylthio carbamides by Bromine".

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The Cauvery-Mettur Project was inaugurated by His Excellency Sir George Stanley on 21st August. The scheme consists of a dam which is the largest in the world and which forms a reservoir to store the flood waters of the Cauvery and supply water to the delta as and when necessary. The reservoir, besides benefitting the ryots of the Tanjore District by ensuring a steady supply of water, provides for the irrigation of a new area of 301,000 acres in the Tanjore District.

* * *

University of Mysore.—The Seventeenth Convocation of the University of Mysore, for conferring degrees, will be held in the Pavilion, Jaganmohan Palace, Mysore, on Wednesday, the 31st October 1934, at 9 a.m.

Admission to the Convocation Hall will be by tickets and intending visitors should apply previously in writing to the Registrar, University of Mysore, Mysore, for the tickets, giving name and occupation. No ticket will be issued for school children. In view of the very limited accommodation available, applications made by any one for more than one Visitor's Ticket cannot be complied with.

Candidates for degrees desirous of bringing a guest, should apply for tickets previously, giving name and occupation of guest. Applications will be complied with to the extent of accommodation available and not more than one guest ticket will be given to any one candidate. Applications should be made before the 15th October 1934.

* * *

Cotton Breeding in Madras.—The Madras Herbaceum Scheme financed by the Central Cotton Committee, has for its objective the evolving of a strain possessing the yield, ginning and spinning qualities of Karunganni, *Gossypium indicum* and the colour and root system of Uppam *Gossypium herbaceum*. Whereas the former yields and gins higher its lint is not so white as that of Uppam and thrives well only in years of good rainfall, the latter type grows even in years of moderate drought. The farmer generally grows the two cottons together as an insurance against a bad season but the inevitable indiscriminate mixing lowers the value of a fine cotton.

The research was started in 1923 and during the first few years attention was concentrated on the isolation of pure lines. Hybridization work is now in progress and although several interesting results have been obtained, it is too early to give a definite verdict on the success or otherwise of the investigation.

* * *

A copy of *Marriage Hygiene*, a new journal devoted to a scientific exposition of sex problems, has been sent to us. Edited by a board of eminent medical men of Bombay the magazine contains contributions from Havelock Ellis, Marie Stopes, Julian Huxley and other eminent scientists who have devoted their energies to educating public opinion concerning sex and sex problems. The Journal is printed by the Times of India Press, Bombay, and the get-up is neat and attractive. It is a welcome addition to Indian Scientific journalism and we wish it a career of usefulness.

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Mechanical Properties of Bricks and Brickwork Masonry. (Building Research Special Report No. 22. H. M. Stationery Office, Price, 1*s.* 5*d.* Post free.)

This special Report describes an investigation which was carried out with the object of collecting information on the mechanical properties of typical bricks and brickwork in use in Great Britain. It was deemed particularly necessary as no authoritative work on the subject has been published since 1905. The test results covering a wide range are collected together in a series of valuable tables. Data on other physical properties are given in an appendix to the report.

* * *

Abnormal Development of the Radicle in Mango.—Mr. Tarachand Nandi, Bangabasi College, Calcutta, writes: "The germination of the mango ordinarily takes place by the bursting of the hard endocarp and the radicle comes out through it on having sufficient moisture and other necessary conditions of germination but in the specimen under consideration, while the mango was still a perfect fruit with epicarp, mesocarp and endocarp, the development of the radicle has considerably progressed. The fruit was perfectly ripe and on the removal of the epicarp and fleshy mesocarp, the radicle was seen to have developed to 3·6 inches and the endocarp showed slight bifurcation.

The probable explanation is sought by the writer to be unfavourable condition of the soil. Such a form of germination is known in the case of viviparous mode of plant-life.

"The hard endocarp is 4·8 inches long and 2·5 inches broad and is popularly known by the name of Fuzli variety of mango; whether it should be explained as viviparous or not requires further investigation. The specimen has been preserved in the Biological Laboratory of the Bangabasi College, Calcutta."

* * *

Aerial Roots in Vitis quadrangularis, Wall.—Mr. S. A. Parandekar, M.Sc., of the Biology Department, Rajaram College, Kolhapur, writes: "An interesting phenomenon of the presence of aerial hanging roots as those in Banyan (*Ficus benghalensis*, Linn.) has been observed in *Vitis quadrangularis*, Wall.

"The plant is being trained on a greenhouse, along with a few others, *e.g.*, Ipomea, Dioscorea, etc. It has gone on the top of the structure (12 ft. high) and spread up extensively; from there it gives off a number of adventitious hanging roots, reminding one of the Banyan plant so commonly met with. A few of such roots are also given off from the lower portions of the plant and they have already entered the soil.

"The plant is known for its quadrangular simpodial stem with stem-tendrils which are leaf-opposed. Now it is found that the adventitious roots mentioned above arise at the nodes from any of its sides which are not occupied by the tendril or the leaf, as shown in the accompanying diagram. A reference to the relevant literature at hand, however, fails to cite the phenomenon; it is thought proper, therefore, to record it as the same might prove of interest to many."

* * *

A Statistical Study of the Maximum Temperatures at Poona (R. J. Kalamkar).—This paper deals with the analysis of Maximum Temperature at Poona from 1880 to 1931. The coefficient of variability of mean monthly maximum temperature is comparatively higher for June and October which are characterised by the setting in and withdrawal respectively of the south-west monsoon. The values of the correlation coefficients for the neighbouring months of autumn and winter are high. Regression equations for forecasting temperatures for the five seven-day periods, *viz.*, November 27—December 3rd, December 4th—December 10th, December 11th—December 17th, December 18th—December 24th and December 25th—December 31st, are obtained from the weekly temperatures of the preceding four weeks.

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We acknowledge with thanks the receipt of the following:—

"Actualites Scientifiques et Industrielles," Nos. 109, 113, 115, 116, 119, 133, 135, 136, 141, 147, 150, 155, 157, 158, 162.

"Journal of Agricultural Research," Vol. 48, Nos. 7–10.

"Memoirs of the University of Cambridge School of Agriculture," No. 6.

"Journal of Agriculture and Livestock in India," Vol. 4, Pt. 4.

"Indian Journal of Agricultural Science," Vol. 4, Pt. 3 and Index to Vol. 2, 1932.

"Biochemical Journal," Vol. 28, No. 3.

"American Journal of Botany," Vol. 21, No. 7.

"Canadian Journal of Research," Vol. 2, No. 1 and Vol. 10, Jan. to June 1934, Index.

"Chemical Age," Vol. 31, Nos. 785—790.

"Berichte der Deutschen Chemischen Gesellschaft," Vol. 67, No. 8.

"Journal of the Indian Chemical Society," Vol. 11, No. 6.

"Experimental Station Record," Vol. 70, No. 6; Vol. 71, No. 1.

"Educational India," Vol. 1, No. 2.

"Indian Forester," Vol. 60, Nos. 8 and 9.

"Forschungen und Fortschritte," Jahrgang 10, 20/21, 22, 23/24.

"Indian Forest Records," Vol. 20, Pts. 7, 8 and 9.

"The Quarterly Journal of the Geological Mining and Metallurgical Society of India," Vol. 5, No. 4; Vol. 6, Nos. 1 and 2.

"Transactions of the Mining and Geological Institute of India," Vol. 29, Pt. 2.

"Monthly Statistics of the production of certain selected Industries of India", April, May and

June 1934. Government of India Publications, Nos. 1, 2 and 3 of 1934–35.

"Medico-Surgical Suggestions," Vol. 3, Nos. 7 and 8.

"Journal of the Indian Mathematical Society," Jubilee Commemoration Volume 20.

"Nature," Nos. 3376–3381 and Index to Vol. 133 Jan.—June 1934.

"Journal of Nutrition," Vol. 8, Nos. 1 and 2.

"The Journal of Chemical Physics," Vol. 2, No. 7.

"Journal de Chemie Physique," Tome 31, Nos. 6 and 7.

"Indian Journal of Physics," Vol. 8, Pts. 5 and 6.

"Review of the Scientific Instruments," Vol. 5, No. 7.

"The Indian Trade Journal," Vol. CXIV, Nos. 1466–1472.

Forthcoming Events.

Society of Biological Chemists, India.—The following papers will be presented during September and October:—(1) 28–9–1934. Mr. R. H. Ramachandra Rao, M.Sc., "The Influence of Aeration in the Diastatic Activity of Steeped Barley" at the *Indian Institute of Science, Bangalore.* (2) 5–10–1934. Mr. B. H. Krishna, M.Sc., A.I.C., "Colloidal Medicaments" at the *Central College, Bangalore.*

Reviews.

"THE SILVER JUBILEE COMMEMORATION VOLUME" of the Indian Mathematical Society.

The Indian Mathematical Society celebrated its Silver Jubilee in December 1932 at Bombay. The twentieth volume of the *Journal of the Society* is published as the Commemoration Volume. The volume contains a report on the progress of the Society during these twenty-five years. It also contains a number of interesting papers contributed by Indian scholars and well-wishers of the Society, on various subjects in Mathematics.

Prof. Watson contributes a paper on the proofs of certain identities in combinatory analysis which are connected with the famous Roger-Ramanujan identities in combinatory analysis. The author uses Ramanujan's notations in the course of the proof. S. S. Pillay has determined the true order of the sum-function of the number of prime factors of n and another allied function with and without the Riemannian hypothesis. E. H. Neville contributes a big paper on "Iteratine interpolation". E. T. Bell has contributed a paper on an algebra of numerical compositions. S. M. Shaw has determined upper and lower bounds of $\frac{A(n)}{n}$ in a closer manner than Behrend where $A(n)$ denotes the number of abundant numbers less than n. G. A. Miller has constructed an infinite system of groups possessing certain given properties and has shown every group possessing certain properties can be extended to a group belonging to the infinite system. K. Ananda Rao has studied some more properties of the elliptic modular function in the neighbourhood of its line of singularities. C. N. Sreenivasaiengar has contributed a paper on the singular solutions of ordinary differential equations of second order. K. Venkatachaliengar has given a simple general method of constructing series whose terms and sum-functions are continuous in an interval and which converges non-uniformly in every sub-interval. S. Chowla has obtained the orders of certain expressions which occur in connection with Waring-Hilbert theorem.

C. V. H. Rao has given a purely projective definition of the ϕ-Conic. T. Hayashi has solved an ancient Japanese mathematical problem. W. Blaschke has proved that a hexagonal 4-web of surfaces is except for topological transformations uniquely determined by three functions each of one variable. D. D. Kosambi has contributed an interesting paper on "The Problem of Differential Invariants". B. Ramamoorti has given a "Covariant specification of the simplex inscribed in a rational norm curve in a space of odd dimensions and circumscribed to a conic inpolar to the Curve". S. Krishnamoorty Rao has studied how quadrics and subregions in a space of degree n are transformed by a given point collineation. A. A. Krishnaswamy Iyengar has contributed some results in connection with oriented circles. Ram Behari has obtained the condition that the osculating quadric of a skew ruled surface be equilateral and has also obtained a new geometrical meaning for the Laguerre function. G. P. Rao has given a method computing Gravity Anomalies. M. Raziuddin Siddiqi has proved the existence and uniqueness of the solution

of some differential equation which occurs in connection with the equation of heat conduction in wave mechanics. K. Nagabhushanam has contributed a paper on the Transformation Theory of Dynamics in the Manifold of states and time. K. K. Mukherjee has a paper on the Normalisation in Wave Statistics.

The editors should certainly be congratulated on the excellent printing and appearance of the volume.

K. V. I.

SM QUELQUES PROPERTIES DES POLYNOMES. By J. Dieudonne. (Hermann & Co., Paris. 24 pp.) 6 francs.

This short monograph deals with the applications of the theory of bounded functions to the properties of polynominals all of whose roots are situated within the unit circle. The connection between them was pointed by I. Schur in connection with his solution of the famous coefficient problem of bounded functions. This book is devoted to the study of less profound relations between them which are capable of easy applications to other problems particularly to those concerning the successive derivatives of these polynominals. The author studies various properties of certain polynominals such as the value of their minimum radius of convexity, etc. The constants obtained are the best possible. Some applications of these are indicated at the end of the book.

K. V. I.

L' ARITHMETIQUE DE L' INFINI. By Maurice Frechet. (Hermann & Co., Paris. 38 pp.) 10 francs.

This book aptly forms the first among the series of books on General Mathematical Analysis which are to be published under the editorial direction of the author. The first thing that one has to study in order to get a complete grasp of analysis is the logical foundation of Infinity. The author has set forth in very lucid terms the definitions of various notions introduced by Cantor, *viz.*, cardinal and ordinal numbers, transfinite numbers. A short account of operations of point sets and the theory of measure are also treated in the book. The author's treatment of the subject is very succinct and brilliant. One great relieving feature about the book is that it does not make use of complicated symbols which are very common in advanced books on real analysis. It is really remarkable that the author has treated the whole subject within a short space of 38 pages. A select bibliography of recent literature on the subject is appended at the end of the book.

K. V. I.

ELEMENTARY MECHANICS, including Hydrostatics and Pneumatics. By Sir Oliver J. Lodge, D.Sc., LL.D., F.R.S. (Chambers Limited, Edinburgh, pp. 308. New Edition. Revised and enlarged). Price 4*s.* 6*d.*

This authoritative and highly useful book on Mechanics was first issued by the author in 1896. It is since revised and enlarged. The present one is a copiously illustrated, new edition of the book.

The author who is the well known scientist and writer, Sir Oliver Lodge, has designed this book to be a really useful hand-book of Mechanics for students. The following are some of the special features of the book :— (1) It is written in a manner so as to be understood by the student who has not specialised in mathematics and even by the layman, without, at the same time, sacrificing accuracy and precision; (2) The subject-matter is treated in such a way that the Laws of Physics have been deduced from first principles and familiar experience rather than from special experiments; and (3) Finally, it is meant to be an easy introduction to a more thorough study of the subject and at the same time a philosophical work.

The subject-matter is treated in a logical and vivid manner and is intelligible even to the student preparing for various examinations by private study. A large number of graded examples have been added and a number of question papers appended.

The Indian student preparing for the various University Examinations will find this book highly useful. It should be indispensable to all libraries.

The printing and the attractive get-up add to the high quality of the book.

B. V. SASTRY.

1350-34.—Printed at The Bangalore Press, Bangalore City, by T. Subramania Aiyar, Superintendent, and Published by P. N. Sastri, M.Sc., A.I.C., A.I.I.Sc., for the "Current Science" Board of Editors, Indian Institute of Science, Hebbal Post, Bangalore.

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